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"It will flourish, if naturalists, chemists, antiquaries, philologers, and men of science in different parts of *Asia*, will commit their observations to writing, and send them to the Asiatic Society at Calcutta. It will languish, if such communications shall be long intermitted; and it will die away, if they shall entirely cease." SIR WM. JONES.

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JOURNAL

OF THE

ASIATIC SOCIETY.

Part II.—PHYSICAL SCIENCE.

No. I.—1875.

I.—*Descriptions of New Species of Mollusca of the genera* Helix *and* Glessula *from the Khasi Hills and Munipur.—By Major* H. H. Godwin-Austen, *F. R. G. S., F. Z. S., &c.—Deputy Supt. Topgl. Survey of India.*

(Received Sept. ;—Read Nov. 4th, 1874.)

(With Plate I.)

The following shells were obtained in the above hills between the years 1868 and 1873, when I was employed in the survey of that tract of country; the work afforded opportunities of visiting almost every part and of bringing together a very large collection of the land and freshwater shells, a complete list of which I hope some day to draw up.

Helix delibrata, Bs., var. fasciata, Plate I, Fig. 1.

Shell openly umbilicated, depressedly globose, rather solid, pale ochraceous epidermis; spire slightly raised, in some specimens quite flat, very prettily striped with brown concentric bands, one or two of which are broader and more pronounced than the rest, especially on the base of shell; some specimens are ornamented with a single band only, last whorl expanding towards aperture and slightly descending; aperture sub-oblique, circular, peristome thick, white, and reflected.

Major diam. 0·82, minor 0·67, alt. 0.38 in.

Hab.—On the high open grassy country of the West Khasi Hills.

True *delibrata*, Bs. unbanded, with flat spire, and a larger shell, is also found in the Khasi Hills.

HELIX (NANINA) ATRICOLOR, n. sp., Plate I, Fig. 2.

Shell imperforate, depressedly conoid, very strong, colour varying from rich bright brown to greenish ochre, pure brown or ochre near aperture, with a glassy surface finely striated; spire flatly conoid, whorls 6½, periphery rounded, flat at base; aperture sub-oblique, broadly lunate, peristome well thickened and slightly reflected near the columella.

Major diam. 0·93, minor 0·85, alt. 0·45 in.

Animal quite black throughout, tentacles long with the extremities paler, extremity of foot short and glandular, as in *Nanina decussata*, Bs.

Hab.—On the higher parts of the North Cachar Hills, never seen to the westward of that portion of the range, and tolerably abundant in certain spots. The colour of the animal is its most distinctive character, shells of this group of Helices being very similar, and the characters of the animals of great importance; I may mention as an instance *N. petrosa*, Hutton, found in damp ravines on limestone at Mussoorie, which has been confounded with other species and the animal of which is almost black; by this character it is identified at once and is rendered a very good species.

HELIX (NANINA) SHISHA, n. sp., Plate I, Fig. 3.

Shell depressedly turbinate, imperforate, exceedingly thin, brittle, transparent, pale greenish horny, sharply keeled; whorls 5, ornamented above with fine and even ribbing, quite smooth at base; aperture oblique, semicircular, lip thin.

Major diam. 0·6, minor 0·51, alt. 0·3 in.

Hab.—Two specimens were found, the one at Moyong, north side of the Khasi Hills, and the other at Nenglo, Naga Hills, in damp forest, but such a fragile form would be probably abundant during the rainy season, and like so many others only then to be seen.

Animal not seen, but in all probability is naninoid. In the plication of the upper surface it is like *N. plicatula*, W. Blf. (J. A. S. B., 1870, Vol. XXIX.) a species the animal of which had not been observed at the time when the shell was described. I now give a short description of it:—pale brown, mottled very evenly with umber over the head and sides, a distinct line of darker colour down the centre of back; tentacles rather thick at base, moderately long gland at extremity of foot, which is rather truncate; length 1·25 inch.

GLESSULA ORTHOCERAS, n. sp., Plate I, Fig. 4.

Shell very slender and elongate, pale grey or white, very finely and regularly ribbed throughout, very solid, apex blunt; whorls 13 to 14, slightly rounded, suture well impressed; aperture oblique, rounded below, outer lip sharply edged and continued as a well developed callus upon the strong thickened columellar margin.

Length 2·32, major diam. 0·4 in.

Hab.—Abundant on the nummulitic limestone of the West Khasi Hills, particularly near Nongumlai, where the finest specimens were collected; a smaller variety occurred on the peak of Laudomodo on gneiss, and was not so solid. This species can be at once distinguished from *G. Casiaca*, Bs. by its white colour and by the absence of the dark brown epidermis that covers the latter; the whorls also are much more rounded, whereas in *Casiaca* they are nearly flat. It is very close to *G. obtusa*, W. Blf., brought from Yunan by Dr. J. Anderson, but is altogether a larger shell and differs in its general form.

Fine *Glessula Casiaca*, I only found to the eastward in the Naga Hills, whence, I suspect, Griffith's specimens were obtained and sent to Benson, who imagined they were from the Khasi Hills.

Glessula illustris, n. sp., Plate I, Fig. 5.

Figured in 'Conchologia Indica', Pl. 102, Fig. 9.

Shell elongately oval, greenish horny, finely striated longitudinally; whorls 7, very slightly rounded, suture moderately impressed, the lip thickened, columellar margin slightly curved and strong, apex blunt.

Length 0·75, major diam. 0·3, length of aperture 0·3 in.

Hab.—Hengdan Peak, North Cachar Hills, at 7000 feet, in forest, also near Nenglo at 6000 feet and in the Lukah Valley, Jaintia Hills, at 1000 feet.

This species is an elongate and larger form of *Glessula crassilabris*, Bs., of which *G. pyramis* is a closer variety; but its much more elongate form and stronger striation make it a good connecting species with *G. Butleri* described further on. The form from the Lukah Valley is a tumid departure from the type figured.

One specimen—alt.	0·75,	major diam.	0·38 in.
Another „ „	0·65	„	0·35 „

I look on all these species as properly varieties, and *G. crassilabris*, very abundant in all the grass country of the Khasi Hills, may be taken as the type; a difference in elevation and condition of habitat, from damp dark forest to hot grassy slopes, having produced modifications of form.

Glessula Burrailensis, n. sp., Plate I, Fig. 6.

Shell turreted, elongate, solid, in fresh state brown and lustrous, finely longitudinally striated; whorls 10, rather flat, suture shallow, apex blunt; aperture sub-vertical, fusiform, angular above, peristome very thick, paler brown on margin, columella strong.

Alt. 1·37, major diam. 0·4 in.

Hab.—The finest specimens were collected under the Peak of Khunho, Eastern Burrail Range; they were also abundant under Japvo at about 7000 feet.

This species is an extremely elongate, solid form of the *crassilabris* section of *Glessula*—and one of the most distinct.

Glessula Butleri, n. sp., Plate I, Fig. 7.

Shell elongately turreted, very thin and brittle, tumid, pale corneous, glassy, very minutely striated, apex very blunt; whorls 8, rather rounded, suture deep, body whorl much swollen and capacious; aperture vertical, pear-shaped, lip rather thin.

Alt. 1·13, major diam. 0·45 in.

Hab.—Eastern Burrail Range at 6000 feet—not a common form.

I name this shell after Captain J. Butler, Political Agent in the Nágá Hills, with whom I had the pleasure of being associated when mapping that very interesting and beautiful district.

EXPLANATION OF PLATE I.

Fig. 1. *Helix delibrata*, var. *fasciata*.
" 2. *H.* (*Nanina*) *atricolor*.
" 3. " " *Shisha*.
" 4. *Glessula orthoceras*.
" 5. " *illustris*.
" 6. " *Burrailensis*.
" 7. " *Butleri*.

II.—*Descriptions of four New Species of Mollusca belonging to the family* Zonitidæ *from the N. E. Frontier of Bengal, with drawings of* Helicarion gigas, *Benson and of a variety of the same.—By Major* H. H. Godwin-Austen, *F. R. G. S., F. Z. S., &c., Deputy Superintendent of the Topographical Survey of India.*

(Received Sept. 1874,—Read January 6th, 1875.)

(With Plates II—III.)

Helicarion Shillongense, n. sp.

Animal ochre colour, the mantle being slightly paler than the rest of the body, there is no longitudinal streaking on the side of the foot, which, viewed under a lens, is covered with minute protuberances evenly distributed; foot beneath dull ochre brown.

Shell horny, thin, long and narrow, pale green in colour. (Plate II, Fig. 1*a*).

Length 0·9″, diam. 0·28.″

The dimensions of these creatures are not so easily taken, the different parts expanding and contracting alternately.

Extremity of foot to posterior end of the mantle,...	1·9	inch.
Mantle,...	1·5	
Anterior end of mantle to head,......................	0·9	
Total,	4·3	
Eye tentacles, ...	0·42	

HELICARION SHILLONGENSE, var., Plate II, Fig. 1.

Animal dark umber brown, body concolorous, the mantle a shade lighter, nearly covering the shell in both varieties, the foot beneath is ash-coloured; when taken fresh there is a slight indentation at the anterior edge of the mantle (*vide* fig.). Shell as in fig. 1 a.

Extremity of foot to posterior edge of mantle, ...	1·70	inch.
Mantle, ...	1·70	
Anterior end of mantle to head, ...	0·95	
Total,	4·35	
Eye tentacles, ...	0·45	

Hab.—Shillong and North Khasi Hills. Both these forms are near *H. Theobaldi*, but may be distinguished at once by the absence of the white stripe on the edge of the left lobe of the mantle, and by the longer form of the shell. The tentacles are longer than in *H. brunneum.*

HELICARION BRUNNEUM, n. sp., Plate II, Fig. 2.

Animal a rich brown, mottled on the mantle with dark sepia, distinctly marked with parallel streaks, that extend from a zigzag line running along the side of foot, the margin of which is edged below with a series of short parallel markings; foot beneath dark ochre. Large portion of shell exposed, which is of same form as that of *H. Shillongense.*

Dimensions when fully extended:

Extremity of foot to posterior end of mantle,......	1·5	inch.
Mantle, ...	1·6	
Anterior end of mantle to head, ...	0·47	
Total,	3·57	
Eye tentacles, ...	0·32	
Breadth of body, ...	0·56	

Hab.—Shillong, Khasi Hills, in grassy localities.

HELICARION NAGAENSE, n. sp., Plate II, Fig. 3.

Animal ochre colour, prettily mottled and dotted with a darker shade of the same, the mantle covers nearly the whole shell; a narrow white line, commencing near the posterior margin of the slit disclosing the shell, extends round towards the respiratory orifice on the right hand side, and in

front another line curves round to the left anterior side (fig. 3*b*). Mucous gland as in *H. gigas*. Length about 3 inches.

Shell ovate, exceedingly thin and brittle (fig. 3).

Major diam. 0·90, minor 0·55 in.

PARMARION ? RUBRUM, n. sp., Plate II, Fig. 4.

Animal of a fine orange pink, grey on under side of the foot; tentacles short, mantle entirely covering the shell, with only a slight trace of a longitudinal opening running back from the anterior left side, three parallel bands of greenish grey along the back of the neck, the eye-tentacles being of the same colour. The gland at extremity of foot with a long, overhanging lobe,

Extremity of foot to posterior end of mantle, ...	0.9	inch.
Mantle, ...	0·8	
Anterior side mantle to head,........................	0·4	
Total length when moving, ...	1·8	

Shell quite rudimentary, minute, granular (fig. 4*b*).

Major diam. 0·14 in.

Hab.—Kohima, Nágá Hills, in brushwood.

The mucous gland in this species differs considerably from that of *Helicarion gigas* and its allies, the upper lobe projecting and hanging over so as to present, when viewed sideways, a narrow horizontal slit.

HELICARION SOLIDUM, Godwin-Austen, Plate II, Fig. 5.

When this species was first brought to notice by me in the P. Z. S., 1872, Plate XXX, the animal had never been observed. It has the form of *Shillongense*, &c., and a specimen from Kohima was dark umber, pinker below, with no mottling on the body; tentacles dark.

In another specimen from the Dunsírí valley, Assam, the animal was pinkish grey with dark mottling, the mantle covered the whole shell and had a slight indentation on the extreme anterior margin; the mucous gland with small lobe above, the extremity of foot cut off rather square.

Total length 2·70, mantle 1·3, mantle to head 0·5 in.

Shell—major diam. 0·44 in. (fig. 5).

The specimen from this locality may be young, but the shell is so similar in form to *H. solidum*, first observed on the peak of Hengdan, Munipur frontier, that I have not separated it.

HELICARION GIGAS, Benson, small var.

I found that typical *gigas*, originally described from Teria Ghat at base of the Khasi Hills, was replaced on the Burrail Range, by the form a drawing of which, together with one of *H. gigas*, I give on Plate III.

Desc.—Animal dark ochre brown with very dark mottlings, particularly distinct upon the margin of the foot.

Shell—major diam. 0·85, minor 0·56 in.

Helicarion gigas was described by Benson as *Vitrina* in J. A. S. B., Vol. V, p. 350.

EXPLANATION OF PLATES.

PLATE II.

Fig. 1. *Helicarion Shillongense*, var. 1*a*. Shell of ditto.

2. „ *brunneum*.

3. „ *Nagaense*. 3*a*. Animal: mantle, side view. 3*b*. Mantle from above. 3*c*. Mucous gland.

4, 4*a*. *Parmarion ? rubrum*. 4*b*. Shell of ditto. 4*c*. Extremity of foot. 4*d*. Head withdrawn below mantle. 4*e*. Mantle from above.

5. *Helicarion solidum*, *G-A*., shell. 5*a*. Mantle from above. 5*b*. Mantle, side view. 5*c*. Mucous gland. 5*d*. Extremity of foot.

PLATE III.

1. *Helicarion gigas*, Bs., nat. size.
2. „ small var. „

III.—*Descriptions of New Operculated Landshells belonging to the genera* Craspedotropis, Alycæus, *and* Diplommatina, *from the Nágá Hills and Assam.—By Major* H. H. GODWIN-AUSTEN, *F. R. G. S., F. Z. S., &c.*

(Received Sept. 1874;—Read February 3rd, 1875).

(With Plate IV).

CRASPEDOTROPIS FIMBRIATUS, n. sp., Plate IV, Fig. 1.

Shell conoidly turbinate, closely umbilicated, thin, covered with a rough dark brown epidermis, longitudinally striate, a leaf-like fringe adorns the periphery of the last whorl, spire conoid, its side concave, apex attenuate, blunt, suture deep; whorls 5, flat above, aperture diagonal, circular, the lip slightly reflected, peristome thin. Operculum multispiral, flat, smooth on outer surface. Animal not seen.

Major diam. 0·19, alt. 0·15 in.

Hab.—Hengdan Peak, Naga Hills, at 7,000 ft., in forest.

Only one specimen was obtained. This is a very interesting shell, as being the first of the genus from this part of India; *Craspedotropis*, esta-

blished by Mr. W. T. Blanford, having been hitherto only known from the hills of Southern India and represented by *C. cuspidatus*, Bs., the fringe on the keel of which is however hairy. Colonel Beddome has, I believe, discovered one or two other new forms.

Alycæus sculpturus, n. sp., Plate IV, Fig. 2.

Shell closely umbilicated, turbinate, horny or grey, with distant well-marked costulation on the upper whorls, smooth below, finely ribbed on swollen part of whorl, still more finely on the constricted portion, spire subconoid; whorls 4, the last slightly swollen, then constricted and slightly swelling again towards the peristome, which is longitudinally undulated; sutural tube moderate, aperture oblique, waved, peristome thickened, expanded a little, double, with four deep undulations on the outer margin and one less developed on the lower, the first undulation forming a deep notch in the peristome near its junction with the last whorl. Operculum as in *A. crispatus*, mihi.

Major diam. 0·14, minor diam. 0·10, alt. 0·08, diam. of aper. 0·06, sutural tube, 0·55 in.

Hab.—Obtained by me on the hill ranges from near Tellizo Peak to the eastward, and on Mungching Hill in Munipur. Abundant.

This species is very close to *A. crispatus*, G-A. from the Khasi and Jaintia Hills (J. A. S. B., Vol. XL, Pl. IV, fig. 1), but is a much more closely wound shell—a character which, when a large series of the two were placed side by side, was found to be constant, and this, with the absence of the ridge on the constriction, marks it as distinct. *A. sculptilis*, Bs., originally described from Burmah, and of which I collected identical specimens in Munipur, is another form near to *sculpturus*, but has no crenulation of the peristome and is plain and ridgeless on the constriction; the three forms pass into one another.

Diplommatina Burtii, n. sp., Plate IV, Fig. 4.

Shell dextral, tumidly and ovately fusiform, colour pale umber or sienna-brown, very finely and closely costulated under lens, almost smooth to the naked eye, spire rapidly attenuate, apex sharp, suture well impressed below; whorls 8, the three last swollen and rounded, those near apex flat, penultimate the largest, the last rising slightly towards the aperture, which is vertical, broad, and well rounded below, peristome double, very thick, continuous, columellar tooth strong.

Hab.—Base of the Eastern Himalaya, at the debouchement of the Burrowli River, Assam, where it was collected by Mr. J. Burt, after whom I have named it, and who kindly collected some other interesting shells in the same locality.

It is a form of the type *D. diplocheilus*, Bs., but the peculiar attenuate spire and tumid shape below are very distinctive.

DIPLOMMATINA SHERFAIENSIS, var., Plate IV, Fig. 5.

A form similar to that from the Peak of Sherfaisip, North Cachar Hills, described in J. A. S. B., Vol. XXXIX, 1870, p. 3, and differing from it only in its much more tumidly fusiform shape and larger size.

Alt. 0·14, diam. 0·09 in.

It was very abundant on the Peak of Japvo at 10,000 ft., and shews an interesting divergence from the form found at the highest elevation of the same range further west. On the Peak of Shiroifurar at an equal altitude but 40 miles to the south-east, the form, with the same essential characters, had again changed into a still larger and more solid shell with a more acuminate spire, yet the differences from the original type are not sufficient on which to found a new species.

DIPLOMMATINA TUMIDA, var., Plate IV, Fig. 7.

Shell elongately fusiform, thin, pale yellowish green, sculpture very faint above, quite smooth on the 3 last whorls, spire attenuate, sides flat, suture moderate; whorls 8½ to 9, the antepenultimate the largest, constriction in front, above the aperture, last whorl ascends slightly; aperture oval, vertical, peristome double, thickened, slightly reflected, columellar tooth small and remote.

Alt. 0·22, diam. 0 13 in.

Hab.—Kézákenomih, Nágá Hills. This shell is a better type of this form of *Diplommatina* than the very tumid shell first described from Asalu; the form changes much in different localities, in some being much more solid and more distinctly and distantly sculptured near the apex; a variety from the Eastern Burrail is 0·20″ in alt., rich dark amber coloured, has the 3 lower whorls smooth and glassy, the columellar tooth still more remote, and the constriction just behind the peristome; it departs so widely from the original type that it might almost be separated. Accurate drawings of a series of specimens are requisite to shew these gradual changes, and these I hope to be able to give hereafter.

DIPLOMMATINA CONVOLUTA, n. sp., Plate IV, Fig. 8.

Shell dextral, elongately fusiform, solid, pale yellowish or greenish horny, very finely costulated towards the apex, 2 last whorls smooth, striated near the aperture, spire with rather flattened sides, suture impressed; whorls 8, antepenultimate the largest, the penultimate constricted at ⅓ turn behind the peristome, the last ascends very sharply, contracting the breadth of the penultimate very considerably; aperture sub-vertical, lying to the right of the axis, peristome circular, solid, double, the tooth small and situated far within the columellar margin, lip scarcely reflected. Animal not seen.

Alt. 0·25, diam. 0·15 in.

Hab.—Slopes of the Eastern Burrail at about 6,000 ft., tolerably abundant.

A very near ally of *D. Jatingana*, G-A., from which it is readily distinguishable by the situation and reduced size of the columellar process, its elongate flat-sided form, and very different sculpture.

EXPLANATION OF PLATE IV.

Fig. 1. *Craspedotropis fimbriata.* With magnified drawing of the leaf-like fringe.
" 2. *Alycæus sculpturus.*
" 3. " *crispatus* (basal side).
" 4. *Diplommatina Burtii.*
" 5. " *Sherfaiensis*, var.
" 6. " *tumida*, type form.
" 7. " " var.
" 8. " *convoluta.*

IV.—*Note on a partially ossified Nasal Septum in* Rhinoceros Sondaicus.

By O. L. Fraser.

(Received 1874;—Read March 3rd, 1875.)

(With Plate V.)

Whilst cleaning the skull of a *Rhinoceros Sondaicus* lately obtained by me in the Sunderbuns, I was much surprised to find a partially ossified *septum narium*—a structure which I had hitherto looked upon as solely characteristic of the fossil Rhinoceros and for any mention of which in a recent species I have looked in vain; indeed Cuvier (Oss. foss. Vol. 2, p. 26,) distinctly states that no such thing occurs in the recent ones.

The specimen in question was a female 5 feet 6 in. high and, though a fully adult one (as the size of a fœtus she was carrying proved), from the unworn condition of her teeth she certainly was not old, so that the ossification could not be merely the result of age, as is so very often the case with the cartilages and even the tendons of mammals, birds, &c.

On looking at some other skulls, I found in two old specimens (one from Java, and the other the locality of which is unknown) traces of where such a structure might have been but had been destroyed either in cleaning or in some other way. In a third (not so old as the two preceding but still an older one than mine) there is distinct evidence of an exactly similar formation to that I am about to describe, though the anterior bone has been lost and part of the posterior portion broken away; this specimen was also from the Sunderbuns.

In some 6 or 7 skulls of *R. indicus* that I examined there was not the slightest indication of it, the vomer being quite distinct, and there being no roughened articulating surface on the inner side of the nasals.

In the first mentioned ♀ specimen, the septum, commencing from the ethmoid, is ossified for about 3 inches; it then divides, the lower portion running to within $5\frac{1}{2}$ in. of the maxillo-premaxillary articulation and being intimately connected with the vomer, along whose channel it runs, the upper portion forming a fringe about an inch deep along the inner surface of the conjoined nasal bones (to which it is ankylosed) to within $5\frac{3}{4}$ in. of their tip (the curved upper walls of the nasal cartilages being also completely ossified and ankylosed to the inner surface of the nasals and maxillaries for the same distance); here there is a break and the bone is perfectly smooth for a space of 2 inches, when there commences a diamond shaped roughened surface, which occupies the whole of the remaining $3\frac{3}{4}$ in. of the inner side of the nasals, and on this was articulated the ossified termination of the nasal cartilage. This is of subtriangular form and consists of a plate of bone $3\frac{7}{8}$ in. long, about $1\frac{1}{2}$ deep, and $\frac{1}{4}$ thick. Its upper edge is expanded laterally to a width (in its greatest measurement) of $1\frac{7}{8}$ in., and forms a deep sulcus, into which the tip of the nasals and the roughened articular surface of their underside fit. The anterior edge of this bone is slightly in advance of the tip of the nasals and is $1\frac{1}{2}$ in. in advance of the anterior point of the præmaxillæ, between which point and the lower edge of the septal bone there is a distance of one inch.

I have since seen the skulls of two other specimens shot at the same place, the one an adult and the other a younger ♂ This structure was present in both.

As can be seen from the accompanying drawing, it bears a strong resemblance to the figure given by Prof. Owen (in his Hist. of Brit. Foss. Mamm.) of *R. leptorhinus*. There is this difference that in *R. leptorhinus* the ossified terminal portion of the septum is ankylosed to the nasals, whilst in *R. Sondaicus* it is not. This, however, might take place at a more advanced age, as, in a foot-note to p. 367, he mentions that the bony septum of *R. ticorhinus* is free until the animal has quite attained maturity. Judging, however, from the old skulls of *Sondaicus* before mentioned, I should not think that it would do so, or it would still remain *in situ* in those skulls. Again, Prof. Owen speaks of the edges of the septum of *leptorhinus* as being complete, whereas in *sondaicus* they are not. They bear distinct marks of the insertion of the posterior cartilage, thus leading one to think that, even if it did not ankylose to the nasals, it might in a very old animal become a completely ossified septum.

Prof. Owen also (Anat. of Vertebrates, Vol. III, p. 356) regards the cloison in *Rh. tichorinus* as indicative of the great development of the horns in that species, but in *Rh. sondaicus* the horn is small (5 or 6 inches as a rule and never exceeding a foot or 18 inches) in the male, and what is very peculiar, the female has no horn whatever. I do not know of any other

Rhinoceros in which this is the case; as in *Rh. indicus*, as well as the double-horned species with which I am acquainted, the female carries a horn or horns, though they are generally smaller than in the male.

EXPLANATION OF PLATE V.

Fig. 1. Side view of the skull with the terminal ossification (*) *in situ.*

„ 2. Section of the skull showing the posterior ossification (**)

„ 3. Inner or under view of the conjoined nasal bones showing (a) the anterior termination of the upper fringe with the ossified nasal cartilages (b. c.) and (d) the roughened articular surface for the terminal bone.

„ 4. Front view of the tip of the nasals with the terminal bone *in situ.*

„ 5. Front view of the bone disconnected.

„ 6. Upper or articular surface of ditto.

V.—*On the Scientific Names of the* Sind "Ibex," *the* Markhor, *and the* Indian Antelope.—*By* W. T. Blanford, *F. R. S., F. G. S.*

(Received 27th May,—Read June 2nd, 1875.)

In the Proceedings of the Asiatic Society for December last, p. 240, Mr. Hume proposed the names of *Capra Blythi* for the Sind wild goat or ibex, and *Capra Jerdoni* for the Suliman variety of the Markhor. The former animal is only incidentally mentioned in Jerdon's Mammals of India, p. 293, and then it is called *Capra Caucasica.** The two forms of Markhor inhabiting Kashmir and Afghanistan are mentioned by Jerdon, but very briefly. As the idea is prevalent in India that neither the Sind goat nor the Suliman Markhor are known to naturalists, I think it may be useful to shew that this view is erroneous, and that neither animal requires a new scientific name.

To take the Sind "ibex" first. This animal is, I think, clearly identical with the wild goat of Persia, Armenia and the Caucasus, and probably of Crete. There is another wild caprine animal in the Caucasus, more nearly allied to the Alpine and Central Asian species of ibex, and this animal is the true *Capra Caucasica.* The wild goat of Persia and Sind has long been known throughout the civilized world as the source of the genuine bezoar,† so greatly famed in former times for its supposed virtue as an antidote to poison.

* It should be borne in mind that the Sind goat does not occur east of the river Indus, which was adopted by Dr. Jerdon, in the Prospectus published at the commencement of his "Birds of India," as the western boundary of the Indian fauna.

† This word is Persian, or rather, a corruption of the Persian *pázahr*, which again is derived from *fá-zahr*, useful or profitable (against) poison.

By many old writers, however, it was supposed that the bezoar was procured from a kind of antelope, and Linnæus confounded the wild goat of Persia, the *Pá-sang* (rock-footed), with the Persian gazelle, the horns of which apparently were described by him as those of his *Capra bezoartica.* The first author who gave a clear account of the bezoar goat was S. G. Gmelin, frequently called the younger Gmelin, who obtained a specimen in the Elburz mountains of Northern Persia close to the southern coast of the Caspian Sea. He, however, erroneously stated that the females have no horns. A head and horns procured by Gmelin were sent to St. Petersburg and carefully described and figured under the name of *Ægagrus* by Pallas in his Spicilegia Zoologica, Fasc. xi, pp. 43-49, tab. v, fig. 2, 3, published in 1776. In this paper, which contains a description of *Capra Sibirica* (or as Pallas terms it *Ibex alpium Sibiricarum*), Pallas points out that the *Ægagrus* is the apparent progenitor, in part at least, of the domestic goat, a view which has been generally admitted. Indeed Gmelin in the 13th edition of the Systema Naturæ united the tame goat, *Capra hircus,* L., with the *Ægagrus* of Pallas, under the name of *Capra ægagrus.*

Schreber and other writers did little more than adopt the name *Capra ægagrus* and copy Pallas's description and figures, which were repeated with an additional representation of the skull and horn-cores in Pallas's Zoographia Rosso-Asiatica. The only difference shewn by these figures from the ordinary horns of the Sind ibex is that, in the head figured by Pallas, the horns are slightly curved towards each other near the tips, which is not the case in most Sind specimens. But any one who has studied ruminants knows that trifling variations of this kind occur, and that the difference is of no importance is shewn by Hutton's remarking* that, out of five pairs of horns in his possession, three were curved towards each other near the tips, and two were not. He also says† that some horns (of *C. ægagrus*) are turned inwards, others outwards, at the extremities. I think there can be no reasonable doubt but that the Sind ibex is identical with *C. ægagrus.*

It is quite unnecessary to enter further into the accounts of the animal in various European works beyond pointing out the confusion which has arisen about its name, and which has doubtless been the cause of its now receiving an additional synonym.

In the first Mammalian Catalogue published by the British Museum, the 'List of the specimens of Mammalia' issued in 1842, the name *Capra ægagrus* does not appear, but certain specimens, which are referred to *Capra Caucasica,* are said to be those described by Col. Hamilton Smith, who was one of the editors of Griffith's translation of Cuvier's 'Animal Kingdom'. The references in the British Museum list under *C. Caucasica* are; first:

* Calcutta Jour. Nat. Hist. II., p. 541. † Ibid. p. 528.

Güldenstädt, Act. Petrop. 1779, t. 16-17; second: H. Smith, Griffith, A. K. V. 871. The first is the original description of *Capra Caucasica*, an animal differing widely from *C. ægagrus*, and having massive horns not angulate in front. To the second I shall refer immediately.

In the next British Museum Catalogue, that of the *Ungulata Furcipeda* published in 1852, p. 153, the *Capra Caucasica* of the former catalogue is placed as a synonym under *Hircus ægagrus*, under which name both the *ægagrus* of Pallas and the tame goat, *Capra hircus* of Linnæus, are included, as they were by Gmelin, and again reference is made to Col. Hamilton Smith's description in Griffith's Animal Kingdom. It thus appears that Dr. Gray, the author of both British Museum catalogues, attributes the mistake about the name to Col. Hamilton Smith. But on turning to Griffith's Animal Kingdom, V, p. 357, I find No. 870, *Capra Caucasica* described as having "the horns triangular, the anterior edge obtuse, irregularly marked with transverse knots and uniform wrinkles," while *C. ægagrus* is quite correctly said to have the "horns forming an acute angle to the front, rounded at the back, transversely ribbed, forming an undulating anterior edge." It appears to me that the species were correctly discriminated by the older writer, and that the mistake of confounding them is Dr. Gray's.

Dr. Adams obtained the name *C. Caucasica* from the British Museum, and thus misled Jerdon, who, it may be seen, mentions in his Mammals, p. 292, that *Capra ægagrus* is found in Persia and other parts of Central and Western Asia; whilst on Adams's authority, though evidently with some doubt, he refers the wild goat of Sind and Baluchistan to *C. Caucasica.*

The synonymy given below will shew the confusion which has existed at the British Museum as to the name of this species. It figures by turns as *Capra Caucasica*, *C. hircus*, *Hircus ægagrus*, and if I am not mistaken *Hircus gazella.* Part of this confusion is I think due to the circumstance that Dr. Gray apparently looked upon the horns of *C. ægagrus* as those of a tame or feral race, and consequently united them with various tame goats. I have shewn that the wild *C. ægagrus* was united to the tame *C. hircus* by Gmelin, and the same author apparently mixed up half a dozen animals, one of which was the bezoar goat of Persia, in his *Antilope gazella.**

Indian naturalists of a former generation were better acquainted with the wild goat of Western Asia than Dr. Gray appears to have been. The first mention that I can find of the existence of *Capra ægagrus* in the neighbourhood of India is in a paper by Captain Hutton published in the Calcutta Journal of Natural History for 1842, where the animal is correctly named, and an excellent description given of its colour at different seasons, its appearance and habits. The accompanying figure is not good. Captain

* *Capra gazella* of Linnæus is, I believe, the Cape Oryx.

Hutton also relates the success of some experiments made by him as to the effect of crossing the wild *Capra ægagrus* with tame goats, but he is disinclined to believe that the former is really identical in species with the latter. In Hutton's 'Rough notes on the Mammals of Candahar' in the Journal of the Society for 1846, he only refers to his previous description, and mentions the final result of his experiments in breeding between *C. ægagrus* and tame goats. The same animal apparently was obtained by Sir A. Burnes in Cabool, and was described by Dr. Lord in Appendix V to Burnes's work on that country, p. 386. He speaks of it as the Markhor-Pazuhu; the (latter word being perhaps a corruption of Pásang,) and notices that it is probably *Capra ægagrus*. A pair of horns obtained by Sir A. Burnes and named *C. ægagrus* by Blyth is in the Asiatic Society's collection, now the Indian Museum.

The following synonymy will enable any one to examine the history of the animal more fully: other references might be given, but the greater portion of them will be found quoted by the authors named. A most elaborate account of the habits of this animal in the Caucasus is given by Kotschy (l. c.).

Capra ægagrus.—*The Pásang or Persian wild goat.*

S. G. Gmelin, Reise. III., p. 493.

Ægagrus, Pallas, Spic. Zool. Fasc. XI, p. 43, Tab. V. fig. 2, 3, (1776).

Caucasan, Pennant, hist. quad. No. 14, p. 51.

Antilope gazella, Gmel., Syst. Nat. I, p. 190, *partim*, nec *Capra gazella*, L.

Capra ægagrus, Gmel., Syst. Nat. I, p. 193, *partim*.

Ægoceros ægagrus, Pall. Zool. Ros. As. I, p. 226, Tab. XVI, fig. 3, 4, 5.

Capra ægagrus, Schreb. Säugth. V, p. 1266, Pl. CCLXXXII.

Ægoceros ægagrus, Wagner, in Schreb. Säugth. V, 1, p. 1315.—Ib. Suppl. Pt. IV, p. 502.

Markhor-Pazuhu, Burnes, Cabool, p. 386, (1842).

Capra ægagrus, Hutton, Calcutta Jour. Nat. Hist. 1842, II, p. 521, Pl. XIX, (a poor figure of the whole animal).—J. A. S. B., XV, p. 161.

Capra Caucasica, Gray, List. Mam. Brit. Mus. (1843) p. 167.—Adams P. Z. S. 1858, p. 525; Wanderings of a naturalist, p. 36.

Hircus ægagrus, Gray, Cat. Ungulata Furcipeda Brit. Mus. (1852), p. 153, *partim*.—Cat. Rum. Mam. (1872), p. 53, *partim*.

Capra hircus, Gray, Cat. Ungulata Furc. Pl. XX, fig. 1, 2, (horns).

Capra ægagrus, Kotschy, Verh. Zool. Bot. Ver. Wien, IV, 1854, p. 201.—Blasius, Säugth. Deutschl. p. 485, fig. 264, (skull and horns).

? *Hircus gazella*, Gray, Cat. Rum. Mam. p. 53, *partim*.

Capra ægagrus, Blyth, Cat. Mam. Mus. As. Soc., p. 176. No. 544, (1863).

Capra Blythi, Hume, Proc. As. Soc. 1874, p. 240.

Pásang, male, *Boz*, female, Persian; *Borz*, Afghan; *Ter* (male) and *Sera*, Sindhi; *Phashin*, Baluchi.

I now turn to the Markhor. The first description of this animal was given by Wagner, under the name of *Ægoceros* (*Capra*) *Falconeri*, Hügel, and I may here remark that this name, given in honour of one of the most eminent of Indian naturalists, must be adopted for this wild goat, as it has priority by 3 years over Hutton's name *Capra megaceros;* Wagner's description having appeared in 1839 in the 'Gelehrte Anzeigen' of Munich. The skin and horns described were obtained by Freiherr v. Hügel from Kashmir. The animal was figured and again described in Wagner's appendix to Hügel's Kashmir, and both figure and description were repeated in the snpplement to Schreber's Säugethiere by the same author. The references are given at full in the synonymy below. The horns of the typical specimen have an unusually open spiral curve.*

Captain Hutton in 1842, described the 'Markhore' or the 'Snake-eater' of the Afghans, under the name of *Capra megaceros*, in the Calcutta Journal of Natural History, and gave a figure of the skull and horns. The form here figured is the Afghan variety, in which the spiral is so slight that the horns approach a straight line. This is the race for which Mr. Hume has proposed the name of *C. Jerdoni*,† but it is clear that if this animal be considered specifically distinct from the Kashmir *C. Falconeri*, Hutton's name must be retained for it. The same name *C. megaceros* was subsequently given by Cunningham in 1854, (Ladák p. 200), to the Kashmir form, but the author was under the impression that the animal was undescribed, and was unacquainted with either Hügel's or Hutton's name.

The most important question, however, is whether the Kashmir and Suliman forms of the Markhor are specifically distinct. At first it appears difficult to believe that animals belonging to the same species have in some instances horns with the open spiral of a corkscrew, and in others straight horns with only a deep spiral groove. As Mr. Blyth justly says‡, the horns vary in curve as much as those of the Koodoo do from those of the Impoofo (or Eland). But on the other hand it should be remembered not only that both forms of horns have long been perfectly well known to naturalists, but

* So different are these horns from those of most Markhor, that some naturalists have supposed them to have been obtained from a tame goat. But as has been shown by Blyth, the spiral in tame goats is always reversed, the anterior ridge just above the forehead turning inwards or towards the other horn at first. In the Markhor this ridge turns outwards. Judged by this test Wagner's figure represents a wild Markhor and not a game goat. I have never myself seen Markhor horns with so open a spiral as those of Hügel's type of *C. Falconeri.*

† It is probable that Mr. Hume's specimens may have been less spiral in form than Hutton's type, for the former are described as resembling an ordinary screw. But as I shall shew, the precise form of the horns varies greatly.

‡ P. Z. S. 1840, p. 80.

that there are large numbers of them in Europe. Blyth, who was certainly not disposed to unite distinguishable forms, was well acquainted with both races, so were Gray, Jerdon, and Adams, yet every one of these naturalists looked upon the different forms of horn as of no specific importance, no other difference having been shewn to exist in the animal, and the form of the horns varying in each locality. There was a living male from near Peshawar recently (and there may be still) in the gardens of the Zoological Society of London with very straight horns, differing, if my recollection is correct, from the type of *C. megaceros* of Hutton, almost as much as this does from the Kashmir race, and on a photograph published by Mr. E. Ward, four distinct forms of Markhor horns are represented. Hutton in his original description of *C. megaceros* says, "They (the horns) are spirally twisted but differ much in the closeness of the volutions, some turning round a straight and direct axis from the base to the apex, others taking a wider or more circular sweep." Indeed so notorious is the fact that these horns vary in curvature, that Blyth for a long time looked upon the animal as a feral race of tame goat and not a truly wild animal*, and Vigne, who met with the Markhor both in Afghánistán and Káshmir, and who noticed the difference in the horns, pointed out that no other distinction existed in the animal.

As in the case of *Capra ægagrus* I give the synonymy below. In this I do not separate the two forms, because, so far as I am aware, no sufficient evidence has yet been adduced to shew that they deserve separation. But should such evidence hereafter be brought forward, I may repeat that the name *Capra Falconeri* will stand for the Kashmir form with openly spiral horns, and that of *C. megaceros* for the Suliman race with the horns more nearly approaching a straight line; it being remembered that much variation exists in both cases.

CAPRA FALCONERI.—*The Markhor.*

Markhor goat, Vigne, Personal Narrative of a visit to Ghuzni, Cabul, &c. p. 86, and vignette, p. 67.—Travels in Kashmir, &c., II., p. 279.

Ægoceros (Capra) Falconeri, Hügel: Wagner, Münch. Gel. Anz. IX, p. 430 (1839).

Markbur, Blyth P. Z. S. 1840, p. 80.—Ann. and Mag. Nat. Hist. VII. 1841, p. 196, note.

? *Rass*, Wood, Journey to source of the Oxus, p. 369 (1841).

Markhor, Burnes, Cabool, p. 387 (1842).

Capra megaceros, Hutton, Calcutta Jour. Nat. Hist. II, p. 535, Pl. XX, (horns), (1842). J. A. S. B., XV., p. 161.

Capra Falconeri, Hügel; Wagner, Beiträge zur Säugeth. Faun. in Hügel's Kaschmir, p. 579, (with a lithograph of the animal), (1844).

Ægoceros Falconeri, Wagner, Schreber's Säugethiere, Suppl. IV, p. 499, Tab. CCLXXXVII E,—Ib. V, p. 466.

* P. Z. S. 1840, p. 80.

Hircus ægagrus, var. 1. Gray, Cat. Ung. Furc. B. M. (1852), p 159.
Capra megaceros, Rapho-chhe, (Markhor) or large wild goat. Cunningham's Ladák, p. 199, Pl. 17, (1854).
Hircus megaceros, Adams, P. Z. S., 1858, p. 525.
Capra megaceros, Blyth, Cat. Mam. Mus. A. S., p. 176 (1863).—Jerdon, Mammals of India, p. 291 (1867).
Hircus Falconeri, Gray, Cat. Rum. Mam. B. M. 1872, p. 53.
Capra Jerdoni, Hume, Proc. A. S. B. 1874, p. 240.
Markhor, Afghan: *Ra-che*, (Rawa-che and Rapho-che ♂ and ♀), Ladák.

I have already referred to the *Capra bezoartica* of Linnæus. This was founded on the various accounts of the bezoar goat given by older writers, amongst whom was Aldrovandi. Blyth has derived the specific name *bezoartica*, which he adopts* for the common Indian antelope, from Aldrovandi, and Jerdon† has followed Blyth in this as in most questions of mammalian nomenclature, so that in both lists this animal stands as *Antilope bezoartica*, Aldrovandi.

Now there is no rule more generally admitted, amongst English zoologists at least, than that specific names given before the publication of the 12th edition of Linnæus's Systema Naturæ in 1766 are invalid.‡ Aldrovandi§ dates from 1621.

* Cat. Mam. Mus. As. Soc. p. 171, No. 528.

† Mam. Ind. p. 275, No. 228.

‡ Unless there is agreement amongst naturalists as to the adoption of rules for nomenclature, it is evident that the sole object of a scientific terminology, that all people of whatever race, despite difference of language, should employ the same term for the same animal, plant, mineral, &c., would not be gained. Any one would suppose that this is a self-evident proposition and that it is to the advantage of all naturalists to agree to fixed rules of nomenclature, but, strange to say, it is incredibly difficult to induce many to consent to any rules. So long as the absurd idea exists that species and genus-makers have rights which require protection, so long will anarchy prevail. The law of priority is established for general convenience and to enforce a fixed nomenclature, not to commemorate the makers of species.

The rules drawn up by a Committee of the British Association in 1842 (Rept. Brit. As. 1842, p. 106) and approved, with slight alterations, by another Committee of the same body in 1865 (Rept. B. As. 1865, p. 25) are the fairest yet proposed for regulating scientific nomenclature, and they should be adopted until other rules are established by general consent. To many naturalists in India these rules do not appear to be known, and I may therefore be excused for referring to them. The rules of Linnæus are republished at the commencement of the "Nomenclator Zoologicus" of Agassiz, but so many of them have been broken habitually for years, that they have become obsolete. Had they been enforced, zoological nomenclature would never have become the chaos it now is, and much advantage would I think be gained if they were better known than they are, and their general spirit at least adopted.

§ Aldrovandi, Quad. Bis. p. 256, under *Capra bezoartica*, gives a figure probably meant for the Indian antelope, but in the text he describes several species, one of them

The *Capra bezoartica* of Linnæus is thus described "*Capra bezoartica cornibus teretibus arcuatis totis annulatis, gula barbata.*" The bearded chin, and the description of the animal's habits refer, I think, to the bezoar goat of Persia, *Capra ægagrus*, whilst the round *arcuate* horns are probably those of a Gazelle, and very possibly those of *Gazella subgutturosa*, the species found in Persia. The description cannot possibly be made to agree with the Indian antelope.

The first description of the Indian antelope published after the appearance of the 12th edition of Linnæus is that of Pallas, whose first fasciculus of the Spicilegia Zoologica, published in 1767, contains a monograph of the genus *Antilope*. The Indian antelope is there described as *A. cervicapra*, p. 18, No. 16, and figured in Tab. I. and II. The *bezoartica* of the same monograph No. II., p. 14, is apparently an oryx.

Gmelin, Schreber, Wagner, and almost all continental writers have adopted Pallas's name for the species, and it has undoubted priority over all others. The same name appears to have been used by most English writers until lately. Error in this case, as in that of *Capra ægagrus*, is to be traced apparently to the British Museum Catalogues,* in which the species was named *Cervicapra bezoartica* upon a well known principle, which although admissible, is extremely objectionable, that of converting the specific name into a generic term and coining a new specific term. This was in the catalogue of 1843, in which the only species retained under the genus Antilope was *A. melampus*. In both the subsequent catalogues, those of 1852 and 1872, the Indian antelope is made the sole member of the genus *Antilope*, Sundevall's genus *Æpyceros* being employed for *A. melampus*, but instead of restoring Pallas's specific name, Dr. Gray has in violation of all rule retained his own (or Aldrovandi's) most objectionable appellation *bezoartica*. It is a question whether this name should be preserved at all, in the first place it is misleading, as the Indian antelope is not the bezoar goat, and in the second place it leads to confusion because the animal is not the *Capra bezoartica* of Linnæus; but if the antelope be placed in the genus *Antilope*, there can be no question that its proper name is *A. cervicapra*.

There remains, however, one question to be decided, and that is, whether *A. cervicapra* is correctly made the type of the genus *Antilope*. This genus was not employed by Linnæus, who placed the species of antelope known to him, with the goats, under *Capra*. The modern genus must therefore be derived from Pallas, who, as already mentioned, published a

probably the wild goat of Persia. It is evident that he meant to give the name to the animal from which bezoar was obtained, and he figured the Indian antelope under the mistaken idea that it was the real bezoar-producing animal.

* List Sp. Mam. B. M., 1843, p. 159.—Cat. Mam. Ungulata Furcipeda, 1852, p. 66.—Cat. Rum. Mam. 1872, p. 40.

monograph of *Antilope* in 1767, (Spic. Zool. No. I.) This monograph includes 16 species, the last of which is *A. cervicapra.*

The old Linnæan rule is that when a genus is divided, the majority of the species shall be retained under the old generic name, and a new name be given to the smaller section. There is another rule adopted by some naturalists, *viz.*, to keep the generic name for the species first placed in the list by the original author of the genus. This last rule has led to absurdities, and, as Dr. Günther has shewn, it would render the common crocodile the type of the genus *Lacerta.* Practically it has been usual to allow any one dividing one of the old genera into several to retain the original name for whichever section he thought best, and the old generic name has usually been preserved for the best known species and its affines.

The first naturalist who divided the old genus *Antilope* was Blainville,* who in 1816 broke it up into 9 generic groups. In the first of these, *Antilope,* he retained 3 species, *A. cervicapra, A. saiga,* and *A. gutturosa.* The next author who divided the genus, Hamilton Smith, retained the same species with some additions, but this is of small importance. Blainville also established a genus *Cervicapra* containing a very miscellaneous collection of species; *A. dama, A. redunca, A. oreotragus, A. saltiana, A. sumatrensis, A. quadricornis,* and several others.

Of the three species left in the genus *Antilope* by Blainville, *A. saiga* was made into a distinct genus by Gray in 1843, and *A. gutturosa* appears to belong to *Gazella* and not to restricted *Antilope.* It is placed in *Gazella* by Sundevall and Sir V. Brooke, whilst Gray in his later catalogues associates it with *Procapra picticauda* of Hodgson, a form which must I think also be referred to the gazelles. The sole remaining representative of the genus *Antilope* is consequently the Indian antelope, which cannot be assigned to the genus *Cervicapra,* because it was not placed in that genus by Blainville, who first used the name, nor is it congeneric with any of the species assigned to *Cervicapra* by Blainville. Gray's genus *Cervicapra* falls to the ground, because if the name be used at all, it can only be employed for Blainville's genus or part of Blainville's genus. On all grounds, therefore, it appears that the correct generic and specific name of the Indian antelope is *Antilope cervicapra.*

* Bul. Soc. Phil. 1816, p. 74. I have not access to this work and quote from Wagner and Fitzinger.

VI.—*On some recent Evidence of the Variation of the Sun's Heat.*—*By* Henry F. Blanford, *Meteorologist to the Government of India.*

(Received June 1st;—Read June 2nd, 1875.)

Since the British Association meeting at Brighton in 1872, at which Mr. Meldrum brought to notice the fact that the Cyclones of the Indian ocean vary in frequency with the period of sun-spot frequency, several attempts have been made to trace out the evidence of a similar periodicity in other meteorological phenomena. Mr. Meldrum and Mr. Norman Lockyer have done this in the case of the rainfall, with the result of shewing that in the Mauritius, Australia, South Africa and some other parts of the world such a variation is to be detected more or less distinctly in the registers. And Professor Köppen has arrived at a similar conclusion in the case of air temperature, a result on which I shall have again to offer some remarks in the sequel. All these results point to the conclusion that the radiation of the sun is not appreciably constant from year to year,* but varies with the appearance and physical state of his surface.

Long prior to any of these discoveries, the possible variation of the sun's heat and of its influence on the earth had been the subject of speculation among solar physicists. According to Professor Wolf, (as quoted by Professor Köppen,) Riccioli, in 1651, shortly after the first discovery of sun-spots, surmised that some coincidence might exist between them and terrestrial weather changes. Sir William Herschell endeavoured to establish such a connexion by discussing one of their remote effects, *viz.*, the rise and fall in the price of wheat in past years. Sabine established a connexion between the solar-spot period and that of magnetic storms; Fritz between the former and the frequency of auroras; and finally, in 1867, Mr. Joseph Baxendell of Manchester succeeded in tracing out a distinct and very striking relation between the number of the sun spots, and the ratio that exists between the difference of the mean maximum temperature of solar radiation and the mean maximum air temperature on the one hand, and that of the mean temperatures of the air and of evaporation on the other.

All these investigations, it will be noticed, have dealt with the problem in an indirect form: that of Mr. Baxendell being, however, the most direct, and perhaps as direct as the data at his command (six years observations of the Radcliffe observatory, and five years of Mr. Mackereth's register at Eccles near Manchester) would admit of. The causes that interfere with the direct transmission of the sun's heat to the earth's surface are so powerful and at the same time so variable, that even with more perfect instruments than

* As was assumed by Mr. Meech in his elaborate treatise on Solar heat in the IXth Volume of the "Smithsonian Contributions to Knowledge."

we possess at present, it is not to be expected that in English latitudes and under her variable and cloudy skies, the temperature of the solar heat incident on the earth's surface, recorded at two stations only, should coincide at all distinctly in variation with that of the heat emitted from the sun. Still, by a very ingenious treatment of the data, Mr. Baxendell succeeded in shewing, with great probability, that the sun's radiation varied in intensity directly with the observed number of the spots during the years 1859 to 1866.

It was still desirable, however, that further and more direct proof should be obtained, and it is obvious that for such a purpose, no country offers more favourable conditions than India; and fortunately, owing in no small degree to the urgent representations of this Society in past years, the means provided by the Government of Bengal, in the establishment of systematic observations throughout its provinces, have put it in my power to bring before the Society this evening, evidence, which if not absolutely conclusive, at least leaves, I think, but little room for doubt, that the old speculations are true; and that the sun's heat varies from year to year, to such an extent as must appreciably affect terrestrial phenomena.

Registers of the readings of a maximum thermometer, the bulb of which is coated with lamp-black and which is enclosed in an exhausted tube,* were commenced at a few stations in Bengal in the latter part of 1867 or the beginning of 1868; at others the observations were begun in subsequent years. The instruments are freely exposed to the sun's rays, supported on forked sticks at a height of one foot above the ground† and their readings have been recorded on all days, whether clear or cloudy. Being very fragile, and exposed without protection, they are unfortunately very subject to breakage, and although therefore their registers extend in most cases over a period of six or seven years, I can find but one station on my list at which the register has been kept continuously for more than five years with one and the same instrument. This fact very much reduces the quantity of data available for discussion. It appears that, from some cause at present unexplained, these thermometers, made by the best London makers, sometimes differ in their readings to the extent of several degrees (I have known differences of 10° and 15°) when exposed under apparently identical circumstances; and there have been hitherto no means of comparing them together in Calcutta in the only effectual way, *viz.*, by exposing them side by side to the solar radiation, and correcting all to some one instrument, arbitrarily selected as a standard. In dealing with the registers then, I

* In one of these tubes which I opened, (that of a thermometer by Messrs. Negretti and Zambra,) I found the residual air to have a pressure at the freezing point of 1·26 ins. about equal to a vacuum of $\frac{1}{24}$.

† At Roorkee the instrument is about 4 feet above the ground.

have been obliged to restrict my comparison to those of consecutive years that have been recorded with the same instrument, and wherever an instrument has lasted over a single twelvemonth only or less, its register has been totally set aside.

The next precaution necessary is to eliminate as far as possible from the individual registers, those irregularities which are due to variations in the state of the sky. This, however, can be done but very imperfectly, otherwise than on the mean of a very large number of observations. It results from the actinometric observations of Pouillet, Kämtz, Quetelet and Althaus, that with a vertical sun, and a sky free from all visible cloud or haze, the proportion of solar heat that penetrates the whole thickness of the atmosphere, and is therefore effective at sea-level, does not amount to more than two-thirds or at the utmost three-fourths of that which reaches the exterior of our atmosphere. Herschell estimates it at the former quantity. But in India, the atmosphere, when cloudless to the eye, is by no means so diathermanous as is here assumed. Sometimes for many days together, with settled weather and a cloudless sky, the sun thermometer gives steady maximum readings, not differing more than one or two degrees. A day follows on which there is a good deal of cloud, and perhaps some rain, and the diathermancy of the atmosphere is so increased in the intervals of the clouds, that the sun-thermometer registers 10° or 15° above any of its previous readings. Such cases occur frequently in all the registers. It is probable therefore that on days registered as cloudless, not less than half the solar radiation and frequently much more is absorbed by the atmosphere. In order to obtain data that shall be fairly comparable, I have in most cases selected those days on which the sky was either cloudless at 10 A. M. and 4 P. M., or had on the average not more than one-fifth of cloud. In the case of the two comparatively cloudy stations Silchar and Port Blair, I have been obliged to extend these limits; in the former case to three tenths, in the latter to one-half. The monsoon months, June to September, are omitted in these tables.

Another method of proceeding which I have adopted in order to verify these results, is to take the two highest readings recorded in each month (including the monsoon months) as the data for comparison.

The four following tables give the results. In Tables I. and II. the comparison is restricted to the registers of those stations and years in which the same instrument has been read continuously for at least two consecutive calendar years. The differences of each pair of years are given separately for each station, and the means of the whole. This method of comparison, however, admits of a very small portion only of the data being utilized, since it excludes all broken years, and therefore in Tables III. and IV. I have adopted a modified course of proceeding, which admits these.

I have taken first for each station separately the temperature differences of each pair of homonymous months in consecutive years, rejecting as before all those in which the instrument has been changed in the interval; and next the mean of all the differences thus obtained for the same pair of months. A rise of temperature is indicated by +, a fall by —.

TABLE I.—*Differences of annual means of black-bulb temperatures with a clear sky (as above defined).*

STATIONS.	1868-9	1869-70	1870-1	1871-2	1872-3	1873-4
Port Blair.		+ 2·2				— 1·7
Cuttack,				+ 1·8	+ 1·4	0
Chittagong,				— 0·8	— 1·9	0
Dacca,				+ 2·6	— 2·2	— 0·4
Hazaribagh,	+ 2·9	+ 1·9				— 4·4
Berhampore,						— 2·4
Patna,	+ 7·7					
Monghyr,		+ 2·9	— 0·1			
Silchar,			— 2·1	0	— 1·8	+ 6·3
Roorkee,			+ 2·3			— 5·6
Sums,	+ 10·6	+ 7·0	+ 0·1	+ 3·6	— 4·5	— 8·2
Means,	+ 5·3	+ 2·3	0	+ 0·9	— 1·1	— 1·0

TABLE II.—*Differences of annual means of two highest black bulb temperatures monthly.*

STATIONS.	1868-9	1869-70	1870-1	1871-2	1872-3	1873-4
Port Blair,		+ 2·9				— 1·3
Cuttack,				+ 2·6	+ 2·5	— 2·3
Chittagong,				— 1·7	— 0·4	+ 1·3
Dacca,				+ 1·7	— 1·2	+ 1·2
Hazaribagh,	+ 2·8	+ 3·7				— 3·9
Berhampore,						— 1·2
Patna,	+ 6·0					
Monghyr,		+ 0·3	— 1·0			
Silchar,			+ 1·8	— 2·3	— 0·3	+ 7·7
Roorkee,			— 0·9			— 3·9
Sums,	+ 8·8	+ 6·9	— 0·1	+ 0·3	+ 0·6	— 2·4
Means,	+ 4·4	+ 2·3	0	+ 0·1	+ 0·1	— 0·3

TABLE III. A.—*Differences of monthly means of black-bulb temperatures with clear sky.*

JANUARY.

STATIONS.	1868-9	1869-70	1870-1	1871-2	1872-3	1873-4
Port Blair,		—1·3	+3·3			—8·2
Cuttack,				—5·0	+8·3	—0·6
Chittagong,				—2·5	—3·0	—1·5
Jessore,	+1·7					
Dacca,				—1·0	—2·6	—3·2
Hazaribagh,	—3·5	+5·9	—1·0			—5·5
Berhampore,		—2·9		—3·4		—11·8
Silchar,			+2·3	—5·1	—1·0	0
Monghyr,		+1·5	+3·8	—4·7		
Patna,	+6·7	+8·6				
Roorkee,			—3·1	—5·2		—12·0
Means,	+1·6	+2·4	+1·3	—3·8	+0·4	—5·3

FEBRUARY.

STATIONS.	1868-9	1869-70	1870-1	1871-2	1872-3	1873-4
Port Blair,		—2·7	+4·9			—2·5
Cuttack,				—5·0	+7·2	—1·4
Chittagong,				—4·7	—0·7	+0·5
Jessore,	+1·6					
Dacca,				—1·7	—0·5	—3·3
Hazaribagh,	+2·2	+2·5	+3·9			—0·8
Berhampore,		—4·2		—5·1		—11·3
Silchar,			+0·5	—5·1	+2·4	0
Monghyr,		+3·2	+1 5	—4·8		
Patna,	+20·2	—3·4				
Roorkee,			—6·8	—0·2		—9·7
Means,	+8·0	—0·9	+0·8	—3·8	+2·1	—3·6

MARCH.

STATIONS.	1868-9	1869-70	1870-1	1871-2	1872-3	1873-4
Port Blair,		+5·4	+2·8			—7·1
Cuttack,				—4·8	+4·0	+0·2
Chittagong,				+0·5	—0·4	—1·5
Jessore,	+2·7					
Dacca,				+4·3	—2·1	+0·2
Hazaribagh,	+5·0	—2·3	+8·2		—3·4	—4.7
Berhampore,		+1·6		—3·1		+13·1
Silchar,			—1·5	—1·9	—1·4	+1·9
Monghyr,		—0·4	+3·6	—1·5		
Patna,	+19·2					
Roorkee,			+0·9	—9·3		—15·3
Means,	+9·0	+1·1	+2·8	—2·3	—0·7	—1·7

APRIL.

STATIONS.	1868-9	1869-70	1870-1	1871-2	1872-3	1873-4
Port Blair,		+3·8	—3·2			+1·0
Cuttack,			—0·6	+2·7	—3·9	+2·3
Chittagong,			—0·2	+1·8	—2·0	—1·7
Jessore,	+4·2					
Dacca,			—4·0	+5·1	—2·9	0
Hazaribagh,	+10·0	—2·1	+1·7		—6·3	—6·2
Berhampore,		+3·6		—7·3		+6·7
Silchar,			—3·5	+1·4	—6·0	+5·3
Monghyr,		—0·3	+1·9	—2·5		
Patna,	+8·4					
Roorkee,			+6·1		+5·6	—8·1
Means,	+7·5	+1·1	—0·2	+0·2	—2·6	—0·2

MAY.

STATIONS.	1868-9	1869-70	1870-1	1871-2	1872-3	1873-4
Port Blair,		—0·7	—3·9			—7·7
Cuttack,			—5·9	+9·7	—5·5	—1·9
Chittagong,			+3·7	—5·6	—1·8	—0·2
Jessore,						
Dacca,			—6·7	+5·4	—3·7	+0·1
Hazaribagh,	+14·2	—6·6	+2·6		—2·6	—4·4
Berhampore,		+9·9			+5·0	—7·2
Silchar,			—1·9	+1·0	—3·2	+5·9
Monghyr,		+1·7	—4·6			
Patna,	+3·9					
Roorkee,			—1·1		+6·7	—4·9
Means,	+9·1	+1·1	—2·2	+2.6	—0·7	—2·5

OCTOBER.

STATIONS.	1868-9	1869-70	1870-1	1871-2	1872-3	1873-4
Port Blair,	— 1·7	— 8·0			— 8·8	+ 4·0
Cuttack,			— 3·8	+ 4·0	+ 0·2	+ 2·5
Chittagong,			— 5·5	+ 4·1	— 4·3	+ 2·4
Jessore,		+ 6·0				
Dacca,			— 0·6	+ 2·5	— 2·3	+ 4·7
Hazaribagh,	— 7·0	+10·6			— 6·9	— 4·1
Berhampore,			+ 0·3		—12·7	— 1·9
Silchar,			— 4·0	+ 4·6	— 1·3	+ 6·4
Monghyr,	— 4·4	+ 9·0	— 2·9			
Patna,	— 5·0					
Roorkee,			+ 4·6		— 1·3	+ 3·8
Means,	— 4·5	+ 8·4	— 1·7	+ 4·0	— 4·7	+ 2·7

November.

Stations.	1868-9.	1869-70.	1870-1.	1871-2.	1872-3.	1873-4.
Port Blair, ...	− 6·4	+ 0·8			− 2·1	+ 2·1
Cuttack, ...			− 0·5	+ 4·6	+ 1·2	− 1·8
Chittagong, ...			− 2·3	− 0·5	− 1·8	+ 3·1
Jessore, ...		+ 5·7				
Dacca, ...			+ 0·1	+ 4·6	− 1·9	− 0·8
Hazaribagh, ...	− 1·2	+ 4·8			− 3·6	− 7·9
Berhampore, ...	− 0·5		+ 1·9		−13·4	− 4·3
Silchar, ...			− 5·9	+ 5·4	− 4·0	+15·4
Monghyr, ...	− 2·8	+ 3·9	− 0·8			
Patna, ...	− 0·3					
Roorkee, ...		− 9·6	+ 3·1		− 3·5	+ 0·3
Means,	− 2·2	+ 1·3	− 0·6	+ 3·5	− 3·6	+ 0·8

December.

Stations.	1868-9.	1869-70.	1870-1.	1871-2.	1872-3.	1873-4.
Port Blair, ...	− 1·7	+ 4·8			− 4·8	+ 4·6
Cuttack, ...			− 2·5	+ 6·2	+ 1·7	− 1·4
Chittagong, ...			− 2·6	+ 0·3	− 0·7	− 1·4
Jessore, ...		+ 2·8				
Dacca, ...			+ 0·2	+ 2·0	− 2·3	− 0·4
Hazaribagh, ...	+ 3·4	+ 2·1			− 0·4	− 5·7
Berhampore, ...	− 4·8		− 0·7		−10·9	− 5·1
Silchar, ...			− 3·4	+ 0·2	− 0·3	+15·5
Monghyr, ...	+ 0·5	+ 4·3	− 3·5			
Patna, ...	+ 8·5					
Roorkee, ...		− 2·6	+ 1·3		− 5·3	+ 1·3
Means,	+ 1·2	+ 2·3	− 1·6	+ 2·2	− 2·9	+ 0·9

Table III. B.—*Mean monthly and annual differences of black-bulb temperatures with a clear sky.*

Months.	1868-9.	1869-70.	1870-1.	1871-2.	1872-3.	1873-4.
January, ...	+ 1·6	+ 2·4	+ 1·3	− 3·8	+ 0·4	− 5·3
February, ...	+ 8·0	− 0·9	+ 0·8	− 3·8	+ 2·1	− 3·6
March, ...	+ 9·0	+ 1·1	+ 2·8	− 2·3	− 0·7	− 1·7
April, ...	+ 7·5	+ 1·1	− 0·2	+ 0·2	− 2·6	− 0·2
May, ...	+ 9·1	+ 1·1	− 2·2	+ 2·6	− 0·7	− 2·5
October, ...	− 4·5	+ 8·4	− 1·7	+ 4·0	− 4·7	+ 2·7
November, ...	− 2·2	+ 1·3	− 0·6	+ 3·5	− 3·6	+ 0·8
December, ...	+ 1·2	+ 2·3	− 1·6	+ 2·2	− 2·9	+ 0·9
Sums,	+29·7	+16·8	− 1·4	+ 2·6	−12·7	− 8·9
Means,	+ 3·7	+ 2·1	− 0·2	+ 0·3	− 1·6	− 1·1

TABLE IV. A.—*Differences of monthly means of two highest black-bulb temperatures in consecutive years.*

JANUARY.

STATIONS.	1868-9	1869-70	1870-1	1871-2	1872-3	1873-4
Port Blair,		0	— 1·0			— 13·0
Cuttack,				— 3·5	+ 7·8	— 0·1
Chittagong,				— 2·0	— 1·3	+ 1·4
Jessore,	+ 1·0					
Dacca,				+ 0·6	— 0·9	— 4·7
Hazaribagh,	— 3·0	+ 9·0	— 2·5			— 4·0
Berhampore,		— 5·7		— 3·2		— 8·5
Silchar,			— 3·0	— 3·0	+ 4·5	+ 1·0
Monghyr,		+ 2·5	— 2·0	— 1·0		
Patna,	+ 17·0	— 7·0				
Roorkee,			+ 2·0	— 4·0		— 10·1
Sums,	+ 15·0	— 1·2	— 6·5	— 16·1	+ 10·1	— 38·0
Means,	+ 5·0	— 0·2	— 1·3	— 2·3	+ 2·5	— 4·7

FEBRUARY.

Port Blair,		— 3·0	— 1·0			— 5·0
Cuttack,				— 7·2	+ 7·4	— 2·3
Chittagong,				— 8·6	— 1·4	+ 4·6
Jessore,	+ 3·4					
Dacca,	..			— 0·6	+ 0·6	+ 0·6
Hazaribagh,	+ 9·0	— 2·5	+ 3·5			— 3·0
Berhampore,		— 6·7		— 0·2		— 10·7
Silchar,			— 0·5	— 3·5	+ 2·0	— 1·0
Monghyr,		+ 0·5	+ 3·5	— 10·5		
Patna,	+ 20·0					
Roorkee,			— 9.5	+ 4·5		— 10·8
Sums,	+ 32·4	— 11·7	— 4·0	— 26·1	+ 8·6	— 24·6
Means,	+ 10·8	— 2·9	— 0·8	— 3·7	+ 2·1	— 3·1

MARCH.

Port Blair,		+ 6·5	+ 1·0			— 5·5
Cuttack,				+ 0·5	+ 0·2	— 2·3
Chittagong,				+ 2·0	— 1·2	+ 0·2
Jessore,	— 2·5					
Dacca,				+ 4·1	— 3·5	— 0·6
Hazaribagh,	+ 2·0	+ 7·5	+ 1·0		— 3·7	— 6·0
Berhampore,		+ 5·7		— 2·5		— 6·7
Silchar,			— 1·0	— 6·0	— 3·0	+ 4·5
Monghyr,		+ 1·0	+ 2·5	— 3·5		
Patna,	+ 12·5					
Roorkee,			+ 0·5	+ 4·2		— 9·6
Sums,	+ 10·0	+ 25·7	+ 4·0	— 1·2	— 11·2	— 26·0
Means,	+ 3·3	+ 6·4	+ 0·8	— 0·2	— 2·2	— 3·2

APRIL.

Stations.	1868-9	1869-70	1870-1	1871-2	1872-3	1873-4
Port Blair,		+ 5·0	— 3·0			— 2·5
Cuttack,			+ 1·0	— 3·2	— 0·4	+ 3·0
Chittagong,			+ 5·6	— 3·5	— 2·0	+ 1·7
Jessore,	— 0·5					
Dacca,			+ 1·4	+ 3·2	— 4·2	+ 1·4
Hazaribagh,	+ 10·5	0	+ 2·0		— 7·5	— 4·0
Berhampore,		+ 2·2		— 6·7		— 6·7
Silchar,			— 5·5	— 4·5	— 4·5	+ 10·0
Monghyr,		— 3·5	+ 1·5	0		
Patna,	+ 2·5					
Roorkee,			+ 1·5	— 3·7		— 7·1
Sums,	+ 12·5	+ 3·7	+ 4·5	— 18·4	— 18·6	— 4·2
Means,	+ 4·2	+ 0·9	+ 0·6	— 2·6	— 3·7	— 0·5

MAY.

Stations.	1868-9	1869-70	1870-1	1871-2	1872-3	1873-4
Port Blair,		+ 3·5	— 2·5			— 5·0
Cuttack,			— 7·0	+ 4·0	— 1·5	+ 1·9
Chittagong,			— 1·0	— 4·2	+ 6·6	— 6·9
Jessore,						
Dacca,			— 3·1	+ 1·6	+ 0·4	— 1·9
Hazaribagh,	+ 7·5	+ 1·5	— 6·0		— 8·0	— 1·2
Berhampore,		+ 7·5		+ 1·2	+ 8·0	— 2·0
Silchar,			+ 8·5	— 2·0	— 6·5	+ 8·5
Monghyr,		+ 3·0	— 7·0			
Patna,	+ 0·5					
Roorkee,			— 2·0		— 1·0	+ 2·4
Sums,	+ 8·0	+ 15·5	— 20·1	+ 0·6	— 2·0	— 4·2
Means,	+ 4·0	+ 3·9	— 2·5	+ 0·1	— 0·3	— 0·5

JUNE.

Stations.	1868-9	1869-70	1870-1	1871-2	1872-3	1873-4
Port Blair,		+ 14·0				+ 6·5
Cuttack,			— 14·0	+ 9·0	+ 15·0	— 19·0
Chittagong,			— 2·5	+ 2·1	— 2·3	+ 5·4
Jessore,						
Dacca,			+ 2·5	+ 1·1	+ 0·1	+ 2·4
Hazaribagh,	+ 3·5	+ 7·5	— 4·5		— 4·5	— 12·0
Berhampore,	+ 3·0	+ 4·0			+ 4·2	— 0·5
Silchar,			+ 17·5	— 1·5	— 7·5	+ 14·5
Monghyr,	+ 5·0	+ 5·0	— 3·5			
Patna,	+ 4·0					
Roorkee,			— 4·0		+ 1·5	— 6·3
Sums,	+ 15·5	+ 30·5	— 8·5	+ 10·7	+ 6·5	— 9·0
Means,	+ 3·9	+ 7·6	— 1·2	+ 2·7	+ 0·9	— 1·1

July.

Stations.	1868-9	1869-70	1870-1	1871-2	1872-3	1873-4
Port Blair, ...		+ 3·0				+ 11·0
Cuttack, ...			+ 1·5	— 3·5	— 0·2	+ 4·9
Chittagong, ...			— 1·4	— 4·5	— 3·4	+ 3·7
Jessore, ...						
Dacca, ...			+ 3·1	+ 0·1	— 5·7	+ 4·1
Hazaribagh, ...	— 5·0	+ 7·0	— 8·0		— 4·2	— 2·2
Berhampore, ...	+ 0·5		— 3·5		+ 1·7	— 4·5
Silchar, ...			+ 9·5	— 3·5	— 1·0	+ 7·5
Monghyr, ...	— 2·0	— 2·0	+ 0·5			
Patna, ...	— 4·5					
Roorkee, ...			— 3·0		+ 11·1	— 12·1
Sums,	— 11·0	+ 8·0	— 1·3	— 11·4	— 1.7	+ 12·4
Means,	— 2·8	+ 2·7	— 0·2	— 2·8	— 0 2	+ 1·5

August.

Port Blair, ...		+ 3·0				— 9.5
Cuttack, ...			— 2·2	+ 2·2	+ 0.9	+ 0·6
Chittagong, ...			— 0·9	— 3·6	+ 3.6	+ 1·3
Jessore, ...						
Dacca, ...			0	+ 7·0	— 0·9	+ 2·4
Hazaribagh, ...	+ 0·5	— 2·0	+ 0·5		— 9·5	+ 2.2
Berhampore, ...	+ 10·0		— 2·7		— 7·0	+ 3·5
Silchar, ...			— 2·0	— 3·0	+ 7·0	+ 5·5
Monghyr, ...	+ 5·0	— 5·0	+ 1·0			
Patna, ...	+ 16·5					
Roorkee, ...			— 0·6		+ 2·8	— 1·2
Sums,	+ 32·0	— 4·0	— 6·9	+ 2·6	— 3·1	+ 4·8
Means,	+ 8·0	— 1·3	— 0·9	+ 0·6	— 0·4	+ 0·6

September.

Port Blair, ...		— 3·5			— 2·0	+ 3·0
Cuttak			— 5·7	+ 14·4	— 10·9	+ 3·7
Chittagong, ...			— 3·0	+ 0·4	+ 1·7	— 1·4
Jessore, ...		— 5·0				
Dacca, ...			— 4·9	+ 2·0	— 1·6	+ 8.1
Hazaribagh, ...	+ 1·5	+ 6·5			— 10·5	+ 0.5
Berhampore, ...	— 1·5		— 1·0		— 9·7	+ 5·5
Silchar, ...			+ 8·0	— 3·0	+ 6·5	+ 2·0
Monghyr, ...	+ 6·5	— 5·5	— 1·0			
Patna, ...	+ 6·5					
Roorkee, ...			+ 1·5		+ 3·1	+ 1·0
Sums,	+ 13·0	— 7·5	— 6·1	+ 13·8	— 23·4	+ 22·4
Means,	+ 3·3	— 1·9	— 0·9	+ 3·4	— 2·9	+ 2·8

October.

Stations.	1868-9	1869-70	1870-1	1871-2	1872-3	1873-4
Port Blair,	— 1·0	+ 6·0			+ 0·5	0
Cuttack,			— 4·0	+ 7·5	— 0·9	+ 0·1
Chittagong,			— 0·4	— 0·5	— 1·7	+ 4·0
Jessore,		— 2·1				
Dacca,			— 3·4	+ 0·4	— 0·1	+ 2·9
Hazaribagh,	— 5·5	+ 7·0			+ 1·5	— 7·5
Berhampore,	+ 8·0		— 1·0		— 11·2	+ 4·0
Silchar,			+ 8·0	— 11·0	+ 2·5	+ 15·5
Monghyr,	+ 0·5	+ 3·0	— 3·0			
Patna,	+ 1·5					
Roorkee,			— 0·5		+ 0·7	+ 2·7
Sums,	+ 3·5	+ 13·9	— 2·3	— 3·6	— 8·7	+ 21·7
Means,	+ 0·7	+ 3·5	— 0·3	— 0·9	— 1·1	+ 2·7

November.

Stations.	1868-9	1869-70	1870-1	1871-2	1872-3	1873-4
Port Blair,	— 5·5	+ 2·0			— 3·0	+ 4·0
Cuttack,			—13·0	+ 9·2	+ 0·8	— 4·7
Chittagong,			— 4·8	+ 7·4	— 3·9	+ 3·9
Jessore,		+ 7·9				
Dacca,			0	— 0·6	+ 1·6	+ 5·6
Hazaribagh,	0	+ 6·5			— 4·7	— 4·2
Berhampore,	+ 1·5		— 3·5		—12·0	+ 2·0
Silchar,			— 4·5	+ 3·5	— 1·5	+ 14·5
Monghyr,	— 6·5	+ 5·5	— 1·5			
Patna,	— 2·0					
Roorkee,		— 7·5	0		— 4·1	+ 4·3
Sums,	—12·5	+ 14·4	—27·3	+ 19·5	—26·8	+ 25·4
Means,	— 2·5	+ 2·9	— 3·9	+ 4·9	— 3·3	+ 3·2

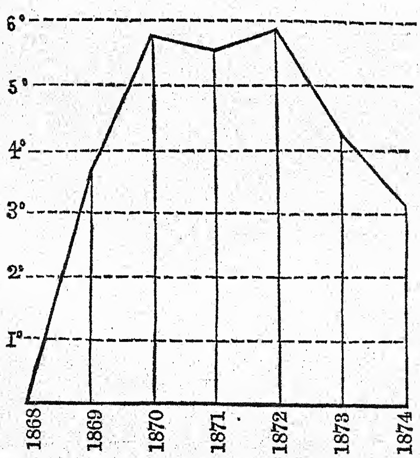
December.

Stations.	1868-9	1869-70	1870-1	1871-2	1872-3	1873-4
Port Blair,	+ 2·0	+ 4·0			+ 2·5	+ 1·5
Cuttack,			+ 1·5	+ 5·2	0	— 4·4
Chittagong,			— 4·2	— 4·8	0	— 1·3
Jessore,		+ 2·7				
Dacca,			— 0·6	+ 0·9	+ 0·4	— 5·9
Hazaribaore,	+ 1·5	+ 0·5			— 2·0	— 0·5
Berhamp	+ 1·2		— 3·5		—12·5	— 9·0
Silchar,			— 2·5	0	— 3·0	+ 14·0
Monghyr,	+ 5·0	— 1·5	— 2·5			
Patna,	— 3·0					
Roorkee,		— 6·0	+ 3·5		— 8·9	+ 0·7
Sums,	+ 6·7	— 0·3	— 8·3	+ 1·3	—23·5	— 4·9
Means,	+ 1·3	— 0·1	— 1·0	+ 0·3	— 2·9	— 0·6

TABLE IV. B.—*Mean monthly and annual differences of maximum black-bulb temperatures.*

MONTHS.	1868-9.	1869-70.	1870-1.	1871-2.	1872-3.	1873-4.
January,	+ 5·0	— 0·2	— 1·3	— 2·3	+ 2·5	— 4·7
February,	+10·8	— 2·9	— 0·8	— 3·7	+ 2·1	— 3·1
March,	+ 5·7	+ 6·4	— 0·8	— 0·2	— 2·2	— 3·2
April,	+ 4·2	+ 0·9	+ 0·6	— 2·6	— 3·7	— 0·5
May,	+ 4·0	+ 3·9	+ 2·5	— 0·1	— 0·3	— 0·5
June,	+ 3·9	+ 7·6	— 1·2	+ 2·7	+ 0·9	— 1·1
July,	— 2·8	+ 2·7	— 0·2	+ 2·8	— 0·2	+ 1·5
August,	+ 8·0	— 1·3	— 0·9	+ 0·6	— 0·4	+ 0·6
September,	+ 3·3	— 1·9	— 0·9	+ 3·4	— 2·9	+ 2·8
October,	+ 0·7	+ 3·5	— 0·3	— 0·9	— 1·1	+ 2·7
November,	— 2·5	— 2·9	— 3·9	+ 4·9	— 3·3	+ 3·2
December,	+ 1·3	— 0·1	— 1·0	+ 0·3	— 2·9	— 0·6
Yearly sums,	+41·6	+21·5	—11·6	— 0·5	—11·5	— 2·9
Means,	+ 3·5	+ 1·6	— 0·9	0	— 0·9	— 0·2

The results obtained by these four different methods, resting on two distinct kinds of data, agree then, in shewing a very decided variation of the incident solar heat; a variation which, in the epoch of its maximum approximately, its rapid rise before that maximum and slower decline after it, agrees with the variation curve of the solar spots. Table III being based on a far larger quantity of data than either of the others, probably gives the most trustworthy results. The curve obtained from this table is given in the adjoining figure.



What proportion the variation may bear to the total incident heat, the present data of course cannot show; and in order to know this, we must await the regular actinometric observations which it is to be hoped may be undertaken at the new Solar Observatory under Col. Tennant at Simla. But judging from the present results, it would certainly appear probable that the variation is such as must exercise a very appreciable influence on the Meteorology of our earth. "It is a dynamical law absolutely universal and one which extends beyond the domain of mere dynamics, that all periodicity in the action of a cause, propagates itself into every, even the remotest effect of that cause, through whatever chain of intermediate arrangements the action is carried out."*

If then the sun's radiation vary directly with the number of the spots and prominences, every other meteorological phenomenon must likewise so vary, rainfall and temperature included, and we have therefore *a priori* grounds for the validity of Meldrum, Lockyer, and Köppen's discoveries. With regard to the rainfall, the coincidence of its variation with that of the sun spots has been only partially verified by the data; but seeing that the rainfall of the larger part of the world has not been taken into consideration in the comparison, this is no more than we should expect. In India, for instance, the registers of most of the few stations that have been compared, fail to conform to the supposed law, but India is but a small part of the region on which precipitation takes place during the SW. monsoon, and I have shewn in a former volume of this Journal, that there are independent grounds for believing, that owing to protracted variations in the distribution of atmospheric pressure in different years, (from what causes arising we are at present unable to determine,) deficient rainfall in one part of the monsoon area is probably compensated in great part by an excessive rainfall elsewhere. As far as the coincidence has been established, the quantity of rain that falls, varies directly with the intensity of the sun's radiation; in other words, with the quantity of energy received from the sun, which of course determines the quantity of water evaporated and afterwards condensed.

This consideration appears to me to throw some light on the apparently anomalous variation of temperature detected by Professor Köppen.† He finds that, in the tropics, the maximum temperature coincides, not with the maximum of the sun-spots, but more nearly with their minimum; which, however, it precedes by ½ to 1½ years. His inference, partly based on this fact, and partly on his erroneous idea of the nature of the spots, is the reverse of that which follows from the facts now adduced. He concludes that the spots are an indication of the diminished radiation of the sun,

* Herschel's 'Meteorology,' p. 137.

† Zeitsch. d. Oesterr. Gesellschaft für Meteorologie, Vol. VIII, pp. 241 and 257.

and adopts the earlier hypothesis of De la Lande and of Zöllner that they are solidified scoriaceous masses floating on the glowing fluid surface ["Schollen fest-gewordener Stoffe auf der glühendflüssigen Sonnenkugel"]. The great discovery of Chacornac and Lockyer in 1865, that the spots are produced by a down-rush of the cooled external atmosphere of the sun, would seem to be unknown to him.

The spots being then, in all probability, an indication of increased radiation, how is this to be reconciled with the facts ascertained by Professor Köppen. Possibly, I think, in this way. The temperatures dealt with by Professor Köppen are of course those of the lowest stratum of the atmosphere at land stations; and must be determined, not by the quantity of heat that falls on the exterior of the planet, but on that which penetrates to the earth's surface, chiefly to the land surface of the globe. The greater part of the earth's surface being, however, one of water, the principal immediate effect of the increased heat must be to increase the evaporation, and therefore, as a subsequent process, the cloud and the rainfall. Now a cloudy atmosphere intercepts the greater part of the solar heat; and the re-evaporation of the fallen rain lowers the temperature of the surface from which it evaporates and that of the stratum of the air in contact with it. The heat liberated by cloud condensation doubtless raises the temperature of the air at the altitude of the cloudy stratum; but, at the same time, we have two causes at work, equally tending to depress that of the lowest stratum. As a consequence, an increased formation of vapour, and therefore of rain, following on an increase of radiation, might be expected to coincide with a low air-temperature on the surface of the land.

It is needless to point out that a vast train of enquiry is opened up by the fact, once established, that the solar heat undergoes a periodical variation. It is I believe of high importance to Meteorology, or will be so when the amount of the variation shall have been ascertained in terms of absolute measurement, and it affords a strong additional incentive to the establishment of an observatory in India, such as have already been founded under the less favoured skies of Germany and on the Rocky mountains, for observing and measuring the variations of the sun. These and their immediate effects are, by prerogative, the study of the tropics.

P. S. *July* 12*th*.—Since the foregoing paper was read, I have examined the register of Darjiling; a station which, although frequently obscured by cloud, has the advantage over stations on the plains, that it is above the level of the dust haze that absorbs so much of the solar heat over the latter. I have discussed the registers by a method somewhat different from either of those followed in the body of the paper, *viz.*, by selecting the three highest recorded sun temperatures in each half month, deducting from each the maximum temperature of the air in the shade on the same days, and taking

the mean of the six differences to represent the solar intensity of the month. The result, as will be seen from the following table, is in complete accordance with that previously arrived at from other data. The same thermometer has been in use throughout.

TABLE V.—*Solar intensity at Darjiling.*

STATIONS.	1870.	1871.	1872.	1873.	1874.	1875.
January, ...		57·8	67·7	59·2	57·8	62·3
February, ...		62·2	62·8	62·3	56·5	60·3
March, ...		63·3	63·5	62·	58·2	57·8
April, ...		64·2	63·2	62·8	55·7	60·2
May, ...	62·2	67·8	66·8	63·8	59·8	
June, ...	67·	68·	67·3	62·5	59·2	
July, ...	63·3	66·2	65·7	60·8	56·3	
August, ...	70·8	65·7	66·8	60·	57·8	
September, ...	71·5	69·3	63·7	62·3	59·3	
October, ...	65·5	68·2	70·	63·3	60·8	
November, ...	62·5	67·3	62·5	57·3	63·3	
December, ...	59·	66·3	59·	53·8	60·5	
Year, ..		65·5	64·9	60·8	58·6	

VII.—*Notes on the Geology of part of the Dafla Hills, Assam; lately visited by the Force under Brigadier-General* STAFFORD, *C. B.—By Major* H. H. GODWIN-AUSTEN, *F. R. G. S., F. Z. S., &c., Deputy Superintendent Topographical Survey of India.*

(Received June 18th,—Read July 7th, 1875.)

(With Plate VI.)

My survey duties with the late expedition into the portion of the Eastern Himalaya known as the Dafla Hills gave me an opportunity of making a few notes on the geology of this portion of the North-eastern frontier, of which so little is known up to the present time.

From the Brahmaputra near Bishnáth and Dunsiri Mukh, the outer range of the Tertiary sandstones is well seen, the steep scarps shewing white against the dense forest with which they are covered. I first entered this outer range by a route up the bed of the Darpang stream, a tributary of the Pichola, when proceeding to clear the hill Dihirhi Párbat for a Trigonometrical station. After leaving Borpathar, the road leads over the plain in a direction WNW., and after 5 miles the shallow bed of the Darpang is followed up and leads directly by a narrow gorge into the hills: these rise suddenly from the level plain of recent detritus, no outlying beds of later age being seen here.

The strata dip about 20° NW., and consist of thick-bedded fine sandstones with strings of water-worn pebbles here and there, but no conglomerate was seen; they weather on the higher ridges into spheroidal masses indented with small holes, in a precisely similar manner to the upper sandstones of the Burrail range. The most conspicuous beds are of a very pale grey colour with black grains. Pieces of lignite are commonly found *in situ* and lying in the beds of the water-courses. The ravines are bounded by very steep sides, and are deep and gloomy. Looking from Dihirhi Párbat westward, the fringing range of the sandstones is well seen, rising at Gorusutia or Peak 1 of the G. T. S. into a sharp scarped point 3,319 feet high, but the ridge descends here and there on the line of strike to below 1000 feet. It presents the same feature all along of a steep scarp towards the plains, and of a slope dipping 20°—25° NNW. towards the main mass of the mountains on the north, from which it is separated by a broad valley or "dhún" drained by the Pomah. This dhún is cut up by numerous ravines and low ridges all buried in dense forest.

To the eastward, 3 miles from Dihirhi Párbat, the sandstone ridge is much subdued. A change takes place in the strike of the mountain mass, and a broad forest-clad plateau, much intersected by ravines and about 200 feet above the plains, extends as far as the gorges of the Dikrang at Harmatti. On this side, the Borpani and Dikrang on their SW.—NE. courses represent and take up the continuation of the Pomah Dhun. At Harmatti is seen another quite recent deposit, in an alluvial plateau of sand, clay, and boulders, on which land for a tea-garden has been taken up. It corresponds to similar terraces in the Western Bhutan Duars, as those on the Jholdaka, &c., but is nowhere more than 30 to 40 feet above the river bed, and is found fringing the older rock slopes for some distance up the valley and to the eastward. It lies against a broad extent of very low intricate hills, which, from this towards the east, are a conspicuous feature. The very hurried examination I was able to make of these beds near Harmatti shewed them to be ferruginous-coloured sandstones and thick conglomerate beds resting on fine blue grey sandy beds dipping 5° to South-eastward. No lignite was seen *in situ*, but rolled pieces were common in the bed of the stream, evidently brought down some distance. At Harmatti similar beds dip 15° SE.; they appear to me to represent the newest beds of this Tertiary series, here extending out into the plains beyond the strike of the 1st or Dihirhi Párbat line of elevation. This line is taken up again east of the Dikrang by a low ridge which bounds the river on the SE. as far as the great bend it takes 10 miles above the junction of the Borpani.

Leaving the stockade at this junction, the winding bed of the Sibjúli is followed, and this 1½ miles farther is joined by the Niosi, a much larger stream. In the bed of the last, the gravels are found to be a great mixture

of gneiss, clay shales, and dark-coloured sandstones belonging to a different series of rocks, with a few pebbles from Tertiary sandstones, shewing that the river must cut through the whole series of stratified rocks up to the metamorphics. This I afterwards found to be the fact. I found here several pieces of silicified wood (a large grass) 8 inches in diameter. The first exposed section, seen about four miles further up the Sibjúli, presented the Tertiary sandstones with a high dip, 75° SE by S.: these are here very dark and hard, thick-bedded, with a slight violet tint. They contain no pebbles, and are of a different character from the outer or Dihirhi group of beds. At the low pass over into the Harjúli they are thin-bedded, softer, and vertical. Passing on northward, on the SE. spur from Tánir Peak, the sandstones are horizontal, and evidently roll over at the Peak to 35° NW., which is the dip all along the crest of this second ridge. Crossing it and proceeding down the spur to the Dikrang, at the few places where the sandstone is uncovered, the dip has become high to the North-west-ward.

But it was on the Dikrang itself that the most interesting section was obtained. On following up the first and eastern stream on the right bank of that river near Camp No. 6, below the village of Shikhi (Phekfis), the first trace of an older series of rocks was found, about a quarter of a mile up the bed, where a dark, hard, heavy sandstone occurs, vertical with a NE.—SW. strike. The soft Tertiary sandstones immediately succeed, having a local dip E. by S. 75°: they are much crushed, very thick-bedded and micaceous, with scattered small pebbles, and they appear the equivalents of the sandstones of Dihirhi. Proceeding up the bed of the next stream (the largest, which I shall, for the sake of distinction, call the Tánir júli,became it drains the northern face of the Tánir ridge), we first come upon the Tertiary sandstones nearly perpendicular, strike SW.—NE.; a very few yards further on are clay shales, very dark and carbonaceous, dip 70° high, NW. Some 50 yards further up the stream, the dip was reversed to 75° ESE., with considerable crushing, and here occurred a thick seam of black carbonaceous shale 5 to 6 feet thick, interstratified with dark close-grained sandstones; this can be traced along the strike NNE.—SSW. for 200 yards, as it crosses the bed of the stream three times. It is rather a crushed splintery coal than a shale, and no doubt would prove better below the surface. Where now exposed it is either in the water or just out of it, in fact, to see it at all one has to wade up the bed of the stream, the jungle on the banks being too thick to move about in.

It was most interesting to come on these rocks in this position, as they are no doubt the representatives of the Damúda Series lately examined and worked out along the base of the Darjeeling and Western Bhútán mountains by Mr. F. R. Mallet,* and first noticed by Dr. J. D. Hooker in 1849, near

* Memoirs of the Geological Survey of India, Vol. XI, Pt. I.

Pankabári. The coal seam has exactly the flaky structure described by Mr. Mallet. The crushing to which it has been exposed has apparently altered its original and probably even thickness, both the upper and lower surfaces being waved irregularly, so that it never retains the same thickness for many yards together along the strike. I could not find time to follow the ravine further, but, at the head of the valley, a full section of these beds would be found along the low ridge connecting the Tánir Lampah with the Misa Párbat ridge. The boulders and gravel consisted principally of (1) the hard sandstone of a pale blue slaty colour, the darkest often speckled with minute grains of quartz (?); (2) a few of the soft Tertiary sandstones, but these apparently soon get ground away; (3) a very hard lighter coloured rock of the Damúda Series; (4) some hard conglomerate; and (5) a few of gneiss from the ridge on the north side of this valley, on which is the little hamlet of Dápú.

I am inclined to think there is unconformity between this Damúda series and the sandstones, but the crushing is great and renders it very difficult to make out clearly; exposed sections being so very scarce. There cannot, however, be here a greater thickness of Damúdas than 1000 feet in the area intervening between the sandstones and the quartzites and gneiss. Overlying the denuded outcrop of the Damúdas, in this lateral valley, is a mass of sandy clay and large sub-angular blocks (some 15 feet long) of the harder strata and quartzitic sandstones, &c.; this, combined with the dense forest, affords a geologist few opportunities of seeing much. The Tánir júli marks the junction of the stratified rocks and the metamorphic series, for some distance, by its wide open valley, the breadth corresponding with the outcrop of the whole Damúda series. The valley of the Dikrang corresponds with the continuation of this outcrop for a long distance to the NE.; its very probable extension westward is marked on the map by several streams excavated on the main line of strike, along the base of the gneissic rocks.

Having once found this thick carbonaceous seam,* it was very easy to follow it up. It crosses the Dikrang in a NE. direction and shews on the left bank close to the suspension bridge, beyond which it leaves the river and becomes covered up with alluvial deposits. Down the Dikrang from this spot, a set of very hard compact sandstone strata, perpendicular and shewing metamorphism, is exposed along the bed of the river, and, about half a mile down, their junction with the unaltered soft Tertiary sandstones is capitally displayed on the right bank. The latter rocks have a high southerly dip, and although having the same strike, gave me a still stronger impression of their unconformity.

* This coal would have to be worked up into an artificial fuel, such as is described by Mr. Mallet at page 60 of his memoir.

To the Damúdas, quartzitic beds succeed, some very white, but I nowhere found an actual contact. On the road to the bridge built by the force above Camp No. 6, a dark green rock is conspicuous by its very trappean appearance: at the bridge a very white quartzite underlies it, dipping 55° SE. These metamorphic rocks have a regular strike SW.—NE., nowhere better seen than from Zorúpútú; that peak with the peaks of Dorkorpútú and Shengorh lying in the main axis of elevation in a true NE.—SW. line. The metamorphics seem to pass by degrees into micaceous schists and hornblendic gneiss (which was noticed 3 miles above the bridge), and then into true granite with large feldspathic crystals, very similar to that of the North Khási Hills, at the Kollong rock, &c. The peaks of Misa Párbat and Shengorh are of this granite. Near Camp 9, under Nanang's village, the gneiss was very talcose, talc occurring in pieces of an inch square or more. The quartzites, mica schists, &c., probably represent Mallet's "Daling Series."

River-terraces of Recent Age.—Near the junction of the Tánir júli with the Dikrang, a higher and a lower terrace are well-marked features: they are composed of sand, clay, and large transported blocks, more or less rounded. The lowest is well seen on the left bank about 20 feet above the river bed at Camp 6. The highest, between that and the bridge about one mile above, has a thickness of some 125 feet. Their deposition here no doubt occurred during the period of glacial extension throughout the Himalayan Range, and they would naturally have accumulated more at the junctions of large lateral valleys than elsewhere. The remains of these terraces are to be traced at intervals up the valley, notably at Pachitah, but the highest is not seen in the valley below Nanang's village and above the junction of the Niúmtay.

The Burroi Gorge.—At the deep pool where the Tertiary sandstones are first seen on the left bank there is an interesting section. The beds are dipping about 50° towards the plains; the denuded surface is smooth and undulating, and here not more than 8 to 10 feet above the water level (March). Proceeding up the river about a quarter of a mile to the next large pool, the same section is again seen, but the upper surface of denuded sandstone is there quite 15 to 20 feet above the river, shewing a very considerable slope of the old earth-surface from the hills. On this surface rests a very recent series of iron-coloured sands and gravels, quite 60 or 70 feet thick, nearly horizontal, but the very slight incline is towards the Southward. These beds abut against the older rocks, which soon commence to rise into well-marked spurs from the outermost range.

These comparatively recent deposits are no doubt the same as those composing the plateau at Beháli Tea-garden, miles out in the plain towards the Bramaputra, and also of the Bishnáth plain. About 300 yards below

the first deep pool (where our camp was pitched), near the head of the next rapid, the last of the Tertiary rocks is exposed in the water and about a foot out of it, and dips south about 70°, the strata apparently falling over into a sharp uniclinal. This feature I have introduced into the section from Harmatti to the Tánir Ridge as it probably extends along the whole base of the hills, but is covered with the more recent alluvial deposits.

To the west of the Burroi, the sandstone range has a general dip NE., but a very conspicuous longitudinal roll occurs at the second large ravine west of the main gorge. The strata immediately east of this ravine dip 50° W., while in the main gorge of the Burroi they have a general easterly underlie, but are a good deal crushed and exhibit high dips. To the west the beds are much less disturbed and again assume regular dips of 30° to 40° northerly, the whole series gradually ascending towards Gorusuttia to the main longitudinal axis of elevation. Looking at the hills 20 miles to the west of the Burroi, the dip of the lowest outer range appeared 20° southerly, producing a long even slope towards the plains.

The Bisnáth Plain.—I first came on this remarkable portion of the country, on the road between Rangsali and Burigaon, just after crossing the Borgang, which has a wide sandy bed, but a volume of water not more than half that of the Burroi. The rise is sudden out of the "kadir" land of the former river, and about 20 to 25 feet, succeeded at from 200 to 300 yards by another of perhaps 3 feet, but very distinctly marked. The surface is perfectly flat, covered with a thin growth of grass, a few of the highest stalks of which may be about 6 or 7 feet high, but it is a short grass for Assam. Patches of forest of a few acres in extent are dotted about here and there, their limits very defined and generally round or oval in shape. The plateau ends abruptly on its southern side, towards the Brahmaputra, but its edge is irregular in outline, having been scooped into by the river in its wanderings from side to side. Traces of the former channel occur in the re-entering angles, in long crescentic pieces of water fringed with marsh and high reeds and grasses; these extend mile after mile to the main river. The view from the plateau, especially off the back of an elephant, is very fine, the dead level surface stretching afar, the line of horizon only broken here and there by a solitary tree or by the embankment of some old tank, for the day has been when all this area was thickly studded with villages. The low scarps of the dry nulla east of Burigang rest-house shew that there the plateau is sandy, and small rounded pebbles, mostly of quartz, occur quite near the top of the section. On the Sudoro, however, away from the influence of the ancient Borgang, red clay predominates, as well as in the scarp to the west of Partabghar, where the plain of Bisnath ends. The thickness of the alluvium here appears much greater, but there is no

real increase; the Giladeri nulla has cut into the alluvium and flows at its very base, and, instead of the usual gradation of fall from terrace to terrace, the whole thickness is seen at once and amounts to some 40 feet. The high level of the Bisnáth Plain is seen from here to extend on the north and north-west by the tea-gardens of Diplonga and Dikro, and an isolated high patch of alluvium occurs about 4 miles west of Sútia, gradually falling by steps at long intervals into the present level of the land on both banks of the Barowli. A series of accurate levels taken over this country would be most interesting, but that it is of the same age as the clay plateau at Tezpúr and many other places in the Assam valley as far down as Gwálpára is certain. It could only have been formed under very peculiar conditions,—in still water, with the surface higher than it now is towards the delta, and with a far larger water supply from the mountains; gradual subsidence in the direction of the delta to the extent of a few feet and change of climate would soon model such outliers of an alluvium probably coeval with the extension of the Himalayan glaciers, the fine mud and sand from which would form just such clays and sands as the plateaus are composed of.

VIII.—*Note on the molluscan Genera* Cœlostele, *Benson and* Francesia, *Paladilhe, and on some species of Land-shells from Aden.—By* W. T. Blanford, *F. R. S., F. G. S.*

(Received June 24th;—Read July 7th, 1875.)

In the 'Annali del Museo Civico di Storia naturale di Genova' for 1872, Vol. III, p. 5, is a description by Dr. A. Paladilhe of *Francesia*, a supposed new genus of Asiatic mollusks. As the typical form of the genus was found in India by Benson, a short notice of this paper may be useful to Indian naturalists, the more so as there is, I think, good reason for doubting whether the genus is really undescribed, and there are some details in the paper in question, and in a subsequent one, containing descriptions of some mollusca from Aden, which require correction.

The genus *Francesia* was proposed by Dr. Paladilhe for a small species found by M. Issel close to Aden, and recognised by its describer as identical with a specimen from the banks of the Jumna sent to him by Prof. Mousson. This Indian shell was received by Mousson from Benson under the name of *Carychium scalare.* M. Paladilhe relates at length the enquiries which he undertook in order to ascertain if this *Carychium scalare* was described, and after consulting various authorities, amongst whom were Messrs. Gwyn Jeffreys and Hanley, he concluded that it was not; Mr.

Hanley assuring him that the name could not even be found in Benson's manuscripts.

It is quite true that no such species as *Carychium scalare* was ever described, but I cannot help feeling some surprise that none of the naturalists consulted should have noticed that a description of the shell was published by Benson in 1864 as the type of a new genus under the name of *Coilostele* (more correctly *Cœlostele*) *scalaris.** There cannot, I think, be any hesitation in identifying the species ; the types were procured from the banks of the Jumna and Betwa, and the new genus *Coilostele* is, though with some little doubt, ascribed to the *Auriculacea* and compared with *Carychium.* The description agrees in all the external characters of the shell with that given by Dr. Paladilhe ; in the latter, it is true, no mention is made of the absorption of the axis in the apical whorls, from which character the name *Cœlostele* is derived, but this might be easily overlooked, and there cannot, I think, be much doubt as to the identity of the two genera *Cœlostele* and *Francesia*, the former name having priority by 8 years.

There appears, however, to be a specific distinction between the Indian and Arabian forms which has escaped the notice of Dr. Paladilhe. The Indian *C. scalaris* is described by Mr. Benson as smooth (*testa lævi hyalina nitida*), whilst the Aden *Francesia scalaris* is said to be finely and very regularly marked with very elegant rather flexuous costulations. I have recently procured specimens of the Indian form from the neighbourhood of Karáchi in Sind, which agree with Mr. Benson's description and are entirely destitute of costulation.

As has already been mentioned, the genus *Cœlostele* was referred by Benson, though not with great certainty, to the *Auriculidæ*, his principal reason being that he found the axis of the spire to be obsolete or absorbed as in *Auricula*, *Pythia*, and several other genera of *Auriculidæ.*† Paladilhe looked upon his *Francesia scalaris* as probably a fresh water mollusk, and he proposed to attach it provisionally to the family of the *Lymnæidæ.*‡ His principal reason, as he states, for believing it to be of aquatic origin, was that the numerous specimens examined by him had the whole shell and especially the aperture free from clay or mud, whereas he had noticed that small terrestrial mollusca, such as *Pupa*, *Vertigo*, &c. when left on the banks of torrents or rivers by floods (the position in which alone *C. scalaris* has

* Ann. and Mag. Nat. Hist. Ser. 3, XIII, p. 136. See also Zool. Record, 1864, p. 235 under *Auriculacea.*

† I find that the axis is equally wanting in the upper part of the spire in Sind specimens.

‡ He subsequently explained that in his opinion it was allied to the singular little genus *Moitesseria*, which is said to be aquatic, and on this account he had believed it allied to the freshwater pulmobranchs (Issel. Ann. Mus. Civ. Gen. IV, p. 525).

hitherto been found), have their surface more or less dirty and their orifice filled with detritus, the reverse being the case with fluviatile species.

Issel, who collected the Aden specimens, in a paper published* soon after that by Paladilhe, gives his reasons for disputing the systematic position assigned to *Francesia* by its author, and for considering it a terrestrial and not a fluviatile mollusk. In his opinion it belongs to the *Helicidæ*, and is allied to *Bulimus*. He points out certain characters which it has in common with *Stenogyra*, *Cæcilianella* and *Ennea*.† I think that there can be very little doubt as to the correctness of Issel's view so far as the terrestrial nature of the mollusk is concerned, and that his opinion of its affinities to the *Helicidæ* are more probable than Benson's supposition that the genus belongs to the *Auriculidæ*, or Paladilhe's that it should be assigned to the neighbourhood of the *Lymnæidæ*. I cannot see that the absorption of the spiral axis, the character upon which alone Benson appears to have relied, is sufficient evidence of affinity, because it is found in gasteropodous genera belonging to widely different families, *e. g.*, in *Nerita*, and there is no other character in which the shell of *Cœlostele scalaris* is shewn to have any close resemblance to *Auricula;* whilst the reason assigned by Paladilhe for supposing his genus *Francesia* fluviatile, the complete freedom of the shell, and especially of the orifice, from clay or sand is certainly an insufficient argument, at all events in those countries in which *Cœlostele* has hitherto been found. I have just examined a small collection of minute shells, picked out from flood deposits in Sind, and amongst them I have found several specimens of *Planorbis* and *Bythinia* with their aperture filled with sand, whilst this appears to be very rarely indeed the case with the minute *Achatina balanus* of Benson, a species which Paladilhe assigns to *Francesia*, but evidently without having a clear idea of the species, for he, immediately afterwards, unless I am greatly mistaken, redescribes it as a new species under the name of *Cæcilianella Isseli.*

It is very singular that the animal of *A. balanus* should never have been observed and that we should be as much in doubt about its real affinities as we are about those of *Cœlostele*. I am strongly disposed to believe that it is very closely allied to a shell described by Crosse from New Caledonia under the name of *Geostilbia Caledonica.*‡ The figure representing this form might almost be mistaken for that of *Achatina balanus*, but the geographical position of *Geostilbia Caledonica* is unfavorable to its identification with

* Ann. Mus. Civ. Gen. IV, p. 521.

† This genus does not belong to the *Helicidæ* but to a distinct family. Conf. Dohrn, Malakoz. Blätt. XIII, p. 129; and Stoliczka J. A. S. B., 1871, XL, pt. 2, p. 159.

‡ M. Crosse very kindly gave me a specimen of this shell, but I have unfortunately left it in England and am unable to compare it with *Achatina balanus*.

the Indian species, which is found in the drier parts of India and apparently in other parts of South-western Asia where the fauna has Arabian and African affinities. The animal of *Geostilbia* has not been examined, but it is said to live underground. It is far from improbable that both *Cœlostele scalaris* and *Achatina balanus* have a similar habitat, and this would account for their not having hitherto been observed living.

I think that there is some possibility too that these forms may be allied to *Ennea*, *Streptaxis*, and *Streptostele*. All have the very peculiar glassy structure characteristic of the *Streptaxidæ*. If this be the case, the animal will probably be brightly coloured, yellow or scarlet, or both. It is to be hoped that some Indian naturalist may succeed in obtaining these species alive and determining their affinities.

If the opinions above expressed be correct, the synonymy of the two forms of *Cœlostele* will be the following:

1. Cœlostele scalaris.

Coilostele scalaris, Benson, Ann. & Mag. Nat. Hist., 1864, Ser. 3, XIII, p. 136.

Hab.—Western and North-western India.

2. Cœlostele sp.

Francesia scalaris, Paladilhe, Ann. Mus. Civ. St. Nat. Gen., 1872, III, p. 10, Pl. I, fig. 1-4.—Issel, ib, IV, p. 521, 530.

Hab.—Aden in Arabia and Sek Said Island, Dahalac Archipelago, Red Sea.

I do not propose a new name for the second species, although I think it requires one, because I have a great dislike to giving names to species which I have not seen, because there is still a possibility that the genus *Francesia* may not be identical with *Cœlostele*, as the peculiar character of the latter, the absorption of the axis in the upper whorls, has not been observed in the former, and thirdly because I consider the practice so prevalent amongst some naturalists of giving new names to everything they are unable to identify extremely objectionable and liable to cause confusion. I trust, however, that either M. Issel or M. Paladilhe will re-examine the Aden shell, and, if, as I anticipate, it proves to belong to the genus *Cœlostele*, re-name it.

Besides *Francesia scalaris*, the following species are described from Aden by M. Paladilhe:

1. *Bulimus Yemenensis.*
2. *B. Samavaensis*, Mousson MS.
3. *B. vermiformis.*
4. *B. cerealis.*
5. *B. lucidissimus.*
6. *Limicolaria Bourgignati.*
7. *Ennea Isseli.*
8. *Pupa Antinorii.*
9. *Cæcilianella Isseli.*
10. *Physa Beccarii.*

Of these, *Cæcilianella Isseli** I believe, as I have already stated, to be identical with *Achatina balanus* of Benson. *Bulimus Samavaensis*, *B. cerealis* and *B. vermiformis* appear all to be varieties of the widely spread and variable *Pupa cœnopicta*, Hutton. This has already been indicated in the case of *B. cerealis* and *B. vermiformis* by Morelet (Ann. Mus. Civ. III, p. 201.) and Issel states that *B. Samavaensis* has also been identified with *B. cœnopictus* by the same naturalist.† It is quite true that the shells named by M. Paladilhe present well marked differences, and that the circumstance of all being found in one place is opposed to the idea of their being races of one species. At the same time it does not follow that all these forms inhabit the same spot because their shells are carried down by the same torrent and mingled in the flood deposits, and I have similarly found two or three varieties together in various parts of India. I have examined a large number of specimens from the drier parts of India, from Upper Burma, Persia, and Abyssinia, and although there are several well marked forms deserving distinctive names, I am inclined to believe that all pass into each other. At the same time I am not prepared to admit with M. Jickeli, as quoted by Issel, (Ann. Mus. Civ. IV, p. 528, note), that these tropical shells are identical with the North American *Pupa fallax* of Say. I have not access to Jickeli's original paper, and cannot say on what his opinion is founded. *Pupa fallax* is found in various parts of the United States, and the peristome is edentulous, and entirely destitute of the parietal tooth which is found more or less developed close to the posterior angle of the aperture in all forms of *B. cœnopictus*. Even should some shells of *B. cœnopictus* be undistinguishable from some of *P. fallax* it would, I think be well to compare the animals before uniting the two.

Issel has pointed out‡ that *Limicolaria Bourgignati* belongs rather to *Stenogyra* than to the genus to which M. Paladilhe assigned it. I am unable to distinguish it from a very common variety of *Stenogyra* (*Opeas*) *gracilis* (*Bulimus gracilis*, Hutton). M. Paladilhe considers it a peculiarly African form, but *Stenogyra gracilis* is found not only in India proper but in the Malay region.

It is remarkable that amongst the shells found near Aden, no form of *Bulimus insularis* (*B. pullus*, Gray) should have been comprised. One has

* My attention was called to this and some of the other identifications given below by my friend Mr. G. Nevill.

† Ann. Mus. Civ. IV, p. 527. I cannot however find the species mentioned by Morelet; can M. Issel has mistaken *Sennaarensis* which Morelet does identify with *P. cœnopicta* for *Samavaensis*?

‡ Ann. Mus. Civ. IV, p. 523, note.

been described by Pfeiffer under the name of *B. Adenensis.* The species is at least as variable and nearly as widely spread as *B. cœnopictus.**

P. S.—Whilst the preceding paper was passing through the press, I received a letter from Colonel R. H. Beddome, in which he told me that he had compared, under the microscope, a specimen of *Geostilbia Caledonica* with a shell which he found in north Canara, and that they were identical. Now the north Canara shell was in all probability *Achatina balanus*, and if this be the case, it follows that the identity of that form with *G. caledonica* which I have long suspected, and to which I have referred at p. 43, is not merely generic, but specific.

* In an excellent account of the land and freshwater shells of Borneo by Issel, also published in the Annali del Museo Civico, Vol. VI, p. 366, I am credited with the authorship of the genus *Optediceros.* This is a mistake. I never invented the genus, but I shewed (Ann. and Mag. Nat. Hist. Ser. 3, XIX, p. 381) that *Optediceros* of Leith, described in the Journal of the Bombay Branch of the Royal Asiatic Society, Vol. V, p. 145, is identical with *Assiminea.* I think, too, it is to be regretted that a shell like *Assiminea cornea*, Pfeiffer *nec* Leith, should still be referred to *Hydrocena*, and *Assiminea carinata*, Lea to *Omphalotropis.* Martens long since pointed out (Malakoz. Blätt. 1864, p. 142,) that the type of *Hydrocena* belongs to a very different family, (*Georissa* is very close to it if not identical,) whilst I have shewn (Ann. and Mag. N. H. 4, III, p. 340) that *Omphalotropis* belongs to the *Cyclostomidæ.* *Assiminea* on the other hand is a Rissoid.

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IX.—*On the General Theory of Duplex Telegraphy.* *By* Louis Schwendler.

(Continued from Vol. XLIII, Part II, 1874.)

In the two preceding investigations* I have given the solution of the *first problem* for the bridge method. This solution established the general result of the *double balance* being the best possible arrangement for the bridge method. In the present paper I shall endeavour to find the solution of the *first problem* for the *differential method,* which in practical importance ranges second to the bridge-method.

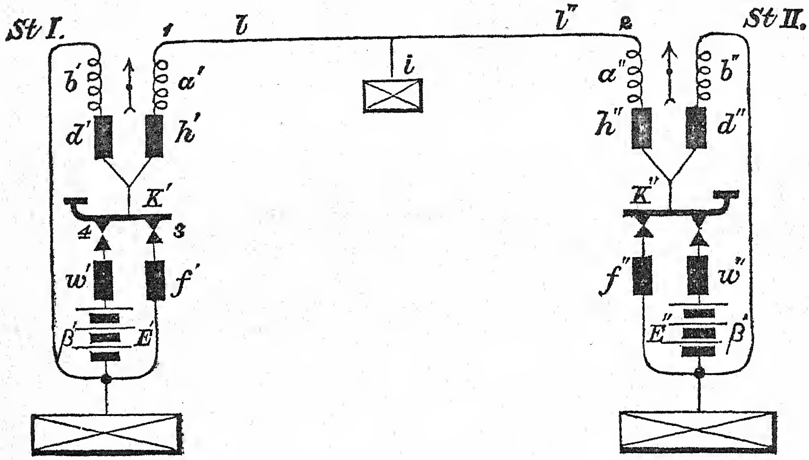
II. Differential method.†

This arrangement for duplex working is based on the well-known method, of comparing electrical resistances "differential method," and Fig. 2 gives the general diagram when this method is applied for duplex working.

* J. A. S. B., Vol. XLIII, Part II, 1874, pp. 1 and 218; Phil. Mag., Vol. 48, 1874, p. 117 and Vol. 49, 1875, p. 108; Journal Telegraphique, Vol. II, p. 580.

† The differential method was originally invented, as stated before, by Mr. Frischen, and Messrs. Siemens and Halske. A particular case of this method was patented by them in England in 1854.

Fig. 2.



Explanation of the Diagram.

E, electromotive force of the signalling battery.

β, internal resistance of the signalling battery.

k, a constant resistance key.

a and b, the coils of the receiving instrument. These coils, for any sent current, have opposite magnetic effects with respect to any given magnetic pole external to the coils; while for any received current, these coils add their effects with respect to that same magnetic pole. By a and b shall also be designated the resistances of the coils.

d, w, f, and h are certain resistances, the necessity of which will become clear hereafter.

i, the resistance of the resultant fault of the line, acting at a distance l' from Station I, and at a distance l'' from Station II, (both l' and l'' expressed in resistances, so that $l' + l'' = L$ equal the "real conduction resistance" of the line).

The other terms, *viz.* L', L'', ρ', ρ'', c', c'', &c., which will necessarily be of frequent occurrence also in this paper, will bear the same physical meaning here as before.

The practical inferiority of the *differential method*, when compared with the *bridge method*, it will be clear at once, is that specially constructed receiving instruments on the differential principle are required. That, therefore, the introduction of Duplex Telegraphy based on the differential method would at once involve also a total change of the receiving instruments hitherto used. This is clearly a serious disadvantage from an administra-

tive and financial point of view. But besides this, without going into details, the differential method has also a very serious objection from a technical point of view. While in the bridge method the balance is obviously independent of the resistance of the receiving instrument, in the differential method the balance is clearly a function of the resistances of the two coils of which the receiving instrument consists, and as these two coils may alter their resistances independently, and not in proportion as indicated by the balance equation, a new element of disturbance is introduced, which the bridge method does not possess.

Besides this, differential instruments are necessarily mechanically more complicated than others, and require therefore superior workmanship, entailing greater expense to arrive at working efficiency.

General expressions for the two functions "D" *and* "S."

In order to obtain the two functions D and S, we have to develop the general expressions for p, P, and Q; say for Station I.

p' in our particular case is the force exerted by the two coils a' and b' on one and the same magnetic pole when Station I is sending and Station II is at rest. This force is clearly the difference of the two forces exerted by the coils a' and b'.

Thus we have

$$p' = A' m' - B' n'$$

where A' and B' are the currents which pass through the two coils a' and b' respectively, when Station I is sending and Station II is at rest, while m' and n' are the forces exerted by these coils when the unit current passes through them. At balance in Station I, $p' = o$

Further $$P' = \mathfrak{A}' m' + \mathfrak{B}' n'$$

where $\mathfrak{A}'$ and $\mathfrak{B}'$ are the currents which pass through the coils a' and b' respectively, when Station II is sending and Station I is at rest (single signals).

Further $$Q' = \mathcal{V}' m' + \mathcal{G}' n'$$

where $\mathcal{V}'$ and $\mathcal{G}'$ are the currents which pass through a' and b' respectively when both stations are sending simultaneously (duplex signals).

To get the most general expressions for these three forces p, P, and Q, we have to fix the signs of the two terms of which they consist. This is best done by considering the forces m and n as absolute numbers, and determining the direction in which they act with respect to one and the same magnetic pole by the direction of the currents passing through the coils a and b.

To fix the signs of the currents, we shall call, arbitrarily, that current positive which passes through the coil a in the sending station, when the negative pole of the signalling battery is joined to earth.

Further, if we suppose at the outset, that the movement of the key k does not alter the complex resistance ρ of its own station, *i. e.*, the fulfilment of the key equation

$$w + \beta = f$$

a condition which is essential, it is clear that the currents $\mathfrak{p}'$ and $\mathfrak{q}'$ are the algebraical sums of the currents A', $\mathfrak{A}'$ and B', $\mathfrak{B}'$ respectively, whence it follows that

$$Q' = (A' + \mathfrak{A}')\, m' + (B' + \mathfrak{B}')\, n'$$

where the currents contain the signs.

Now, with respect to the manner of connecting up the two signalling batteries E' and E'', we have the following two different cases :

1*st*. The same pole of the signalling battery is connected to earth in each station, thus :

$$p' = \pm A'\, m' \mp B'\, n'$$
$$P' = \mp \mathfrak{A}'\, m' \mp \mathfrak{B}'\, n'$$
$$Q' = (\pm A' \mp \mathfrak{A}')\, m' + (\mp B' \mp \mathfrak{B}')\, n'$$

where the upper signs are to be used when the negative poles of the signalling batteries are connected to earth in both stations, and the lower signs when the positive poles of the signalling batteries are connected to earth in both stations.

2*nd*. Opposite poles of the signalling batteries are connected to earth in the two stations, thus :

$$p' = \pm A'\, m' \mp B'\, n'$$
$$P' = \pm \mathfrak{A}'\, m' \pm \mathfrak{B}'\, n'$$
$$Q' = (\pm A' \pm \mathfrak{A}')\, m' + (\mp B' \pm \mathfrak{B}')\, n'$$

where the upper signs are to be used when the negative pole in Station I and the positive pole in Station II are connected to earth, and the lower signs when the reverse is the case.

Subtracting in either of these two cases P' from Q', it will be seen that invariably

$$S' = Q' - P' = p'$$

or that, on account of having fulfilled the key equation $w + \beta = f$, the difference of force by which single and duplex signals are produced is equal in magnitude and sign to the force by which balance is disturbed. Further, that it is perfectly immaterial whether the same or opposite poles of the signalling batteries are put to earth. For reasons already explained I prefer to use the negative poles of the signalling batteries to earth in both stations, and this alternative we will suppose is adopted.

Thus we have :

$$p' = A'\, m' - B'\, n'$$
$$P' = -(\mathfrak{A}'\, m' + \mathfrak{B}'\, n')$$
$$Q' = (A' - \mathfrak{A}')\, m' - (B' + \mathfrak{B}')\, n'$$

If we now substitute for A', B', $\mathfrak{A}'$, $\mathfrak{B}'$ their values, we get :

$$p' = \frac{E'}{N'}\,\Delta'$$

$$P' = -\frac{E''\,(b''+d'')}{N''}\,\mu'\,\lambda'$$

and $$Q' = -\frac{E''\,(b''+d'')}{N''}\,\mu'\,\lambda' + \frac{E'}{N'}\,\Delta'$$

the sign of p' being contained in Δ', and where

$$N' = f'\,(b'+d'+a'+h'+c') + (b'+d')\,(a'+h'+c')$$
$$N'' = f''\,(b''+d''+a''+h''+c'') + (b''+d'')\,(a''+h''+c'')$$

$$\mu' = \frac{i}{i+l'+\rho'}$$

$$\Delta' = (b'+d')\,m' - (a'+h'+c')\,n'$$

$$\lambda' = m' + \frac{f'}{b'+d'+f'}\,n'$$

Thus the general expressions for the two functions D and S are :

$$\left.\begin{aligned} D' &= \frac{p'}{P'} = \frac{E'}{E''}\cdot\frac{N''}{N'\,(b''+d'')}\cdot\frac{\Delta'}{\mu'\,\lambda'} \\ S' &= p' = \frac{E'}{N'}\,\Delta' \end{aligned}\right\}\text{for Station I.}$$

and $$\left.\begin{aligned} D'' &= \frac{p''}{P''} = \frac{E''}{E'}\cdot\frac{N'}{N''\,(b'+d')}\cdot\frac{\Delta''}{\mu''\,\lambda''} \\ S'' &= p'' = \frac{E''}{N''}\,\Delta' \end{aligned}\right\}\text{for Station II.}$$

Rigid fulfilment of the two functions $D = o$ and $S = o$.

D can only become zero, for finite resistances of the branches, if

$$p = S = o$$

i. e. if $$\Delta = o$$

Now, to keep $\Delta = o$ we may adopt two essentially different modes of re-adjustment, namely :—

Either leave the coils and their armatures stationary, and adjust balance by altering the resistances of the branches $(a+h)$ and $(b+d)$ separately or simultaneously, or leave the resistances of these branches constant, and move the coils or their armatures. These two cases are to be considered separately.

(*a.*) *Re-adjustment of balance by altering the resistances of the branches.*

As a and b are resistances which in the form of coils have to exert magnetic force, it is impracticable to suppose them variable. If they have been once selected, they must necessarily be kept constant, whence it follows

that the re-adjustment of balance is restricted to a variation of the resistances h and d.

But as ρ is a function of h and d, to establish balance by altering one of them only, would invariably result in an alteration of ρ, and consequently *immediate* balance would become an impossibility.

Thus in order to readjust balance, and at the same time to keep ρ constant,* we must vary h and d simultaneously.

Now, it can be proved in exactly the same manner for the differential method as it was for the bridge, that in order to make the disturbance of balance for any given variation in the system as small as possible we must make ρ as large as possible, whence it follows from the form of ρ that

$$f = b + d$$

the "*regularity condition*" for the differential method.

But since

$$f = w + \beta$$

it follows that to re-establish balance by an alteration of the resistances h and d while a, b, β, and ρ keep constant, we have to vary *all* the four branches h, d, w and f simultaneously, in such a manner that their variations fulfil the following condition:

$$\delta f = \delta d = \delta w = -(2\ \delta h)$$

which is simple enough to allow of its practical application; but which nevertheless shows again the inferiority of the *differential method* as compared with the *double balance*, *i. e.*, in order to fulfil *immediate balance*, the *key equation*, and the *regularity condition* for the *differential* method, we have to make the four branches of the system simultaneously variable, while in the *double balance* the same effect can be obtained by having *one* branch only variable (the b branch).

It is worth while to mention here that there is a special case of obtaining *immediate balance* for the differential method by the adjustment in one branch, namely, when $f = o$, for then ρ would be independent of d, and therefore balance could be obtained by varying d without altering p.

However, on account of the key eqaation $f = w + \beta$, it would follow from $f = o$, that β must be zero also, which represents a physical impossibility inasmuch as the internal resistance of galvanic cells cannot be reduced

* $\rho = a + h + \dfrac{(b + d) f}{b + d + f}$

keep a, b and f constant and vary h and d, whence we should have:

$$\delta\rho = (b + d + f)\ (b + d + f + \delta d)\ \delta h + f^2\ \delta d = o$$

an equation, which it is always possible to fulfil for any variations of h and d if taken of opposite signs, although it may be difficult to achieve it practically by a simple motion, such as that of turning a handle. The absolute value of these variations depends of course on the variation of c which disturbs the balance, and in order to have accelerated balance we ought to decrease h and increase d when c increases, and *vice versâ*.

to zero, not even approximately. Besides the E. M. F. requisite for duplex working being necessarily comparatively large, β will always be a quantity which cannot be neglected against the other resistances of the system, even if the single cells were of small resistance.

But supposing it were practicable to construct a battery of exceedingly low internal resistance, then, as $f = b + d$, it would be necessary to make $b = o$ and $d = o$ another physical impossibility, as b must consist of convolutions to produce magnetism, and d must be variable to produce balance.

This solution $f = b + d = w + \beta = o$, or even each of these three branches of an only exceedingly small resistance, must therefore be rejected.

(*b.*) *Adjustment of balance by moving the coils or armatures.*

This, it will be clear, is *the* solution for *immediate balance*, for such a mode of adjustment would involve no relation between the resistances of the three branches, leaving their determination free for other purposes. In order that the slightest movement of the two coils, or their armatures, may produce the required balance, it will be best to move both the coils or armatures simultaneously in the same direction. In fact to be able to produce balance, no matter how great the variation in the resistance of the line may become, it will be necessary to make the coils movable for the changes of sea sons, and the armatures for the daily changes.

It is clear that the differential method, when balance is adjusted by the movement of the coils or armatures, can alone be compared in efficiency with the *double balance*, and the superiority of the latter is most striking. While *immediate balance*, and the fulfilment of the other two essential conditions, can be obtained with *the double balance method* within any given range by a variation of the resistance in *one* single branch (b branch), this same result with the differential method can only be arrived at by either supposing four branches simultaneously variable, or by supposing the coils and armatures movable,—both pre-supposing complicated mechanical arrangements requiring delicate workmanship and being liable to get out of order.

Rapid approximation of the two functions D *and* S *towards zero.*

Supposing the fulfilment of the key equation as one of the most essential conditions, we know that

$p = S$ for each station invariably.

Now for Station I we have

$$p' = S' = E' \frac{\Delta'}{N'}$$

where

$$\Delta' = (b' + d')\, m' - (a' + h' + c')\, n'$$

$$N' = f'\,(b' + d' + a' + h' + c') + (b' + d')\,(a' + h' + c')$$

If we call c' that value of the measured circuit, which for any given values of the two branches $b' + d'$ and $a' + h'$ produces balance in Station

I, *i. e.* for which $\Delta' = o$, then if c' varies $\delta c'$, we have $\Delta' = n'\,\delta c'$, while N' becomes $N' + \delta N'$.

Thus we have

$$S' = E' \frac{n'\ \delta c'}{N' + \delta N'}$$

$$S' = \frac{E'\, n'}{f' + b' + d'} \cdot \frac{\delta c'}{a' + h' + \dfrac{f'\,(b' + d')}{f' + b' + d'} + c' + \delta c'}$$

but as $a' + h' + \dfrac{f\,(b' + d')}{f' + b' + d'} = \rho'$ the complex resistance in Station I, and as further $\delta c'$ can be neglected against c', we have finally:

$$S' = E' \frac{n'}{f' + b' + d'} \cdot \frac{\delta c'}{c' + \rho'}$$

Further n', the force exerted by the coil b' on a given magnetic pole when the unit current passes through the coil, can be expressed as follows:

$$n' = r' \sqrt{b'}\,*$$

where r' is a coefficient depending only on the dimensions and shape of the coil, on the manner of coiling the wire, and on the integral distance of the coil from the magnetic pole acted upon.

Thus we have

$$S' = E' \frac{r' \sqrt{b'}}{b' + f' + d'} \cdot \frac{\delta c'}{c' + \rho'} = E'.\ W'.\ \theta'$$

Now supposing the factor W' constant,† S' becomes smaller the smaller θ is.

In the second part it has been proved quite generally that θ decreases permanently with increasing $\rho'\ \rho''$, no matter to what special cause the variation of c' is due, whence again it follows that ρ should be a maximum.

From the form of ρ however we see that for any given sum $b + f + d$, ρ becomes largest if

$$f = b + d$$

which is "*the regularity condition*" of the differential method.

* This expression supposes that the thickness of the insulating covering of the wire can be neglected against the diameter of the wire, which is allowable. r' is a constant with respect to b'.

† That W' can be kept constant while θ' decreases and $\dfrac{f'}{b' + d'}$ varies, and $f' + b' + d'$ is constant, it will be clear is possible, for if $d' > o$ the variation of $b' + d'$ may be considered entirely due to a variation of d', equal and opposite in sign to the variation of f'. If $d' = o$ then we must consider r' variable with b' in order to keep W' constant while $\dfrac{f'}{b'}$ varies, which is admissible since the position of the coils has not been fixed as yet.

To have S' therefore for any variation as small as possible, we must make $f = b + d$. Substituting this value of f we get an expression for S' which shows that it has an absolute maximum for b but no minimum, from which we conclude that b should be made either very much smaller or very much larger than the value which corresponds to a maximum of S, but no fixed relation between b and d or a can be found.

In order to prove that $b + d = f$ is *the solution*, we must now show that it also makes D as small as possible.

But as
$$D = \frac{S}{P}$$
we have only to show that the regularity condition $b + d = f$, makes P either as large as possible, or, which would be still better, a maximum.

Now
$$P' = A'' \mu' \lambda'$$
where A'' is the current which enters the line at point 2 (Fig. 2) when Station II is sending alone, while μ' is the factor which determines the loss through leakage of the line, and λ' is the factor to which the magnetic force, exerted by the current $A'' \mu'$ in Station I, is proportional.

μ' as well as λ' are functions of the resistances in Station I only* but not of those in Station II.

Now for constant values of μ' and λ' (*i. e.* leaving everything in Station I constant) P' becomes larger the larger A'' is:
$$A'' = E'' \frac{b'' + d''}{N''}$$

Substituting its value for N'', and dividing numerator and denominator by $b'' + d''$, we get
$$A'' = \frac{E''}{f'' + \dfrac{f''(a'' + h'')}{b'' + d''} + a'' + h'' + c''\left(1 + \dfrac{f''}{b'' + d''}\right)}$$

Supposing balance in Station II rigidly fulfilled, we have
$$(b'' + d'')\, m'' - (a'' + h'' + c'')\, n'' = o.$$
$$\therefore \quad c'' = (b'' + d'')\frac{m''}{n''} - (a'' + h'').$$

Substituting this value of c'' in the expression for A'' and reducing, we get
$$A'' = \frac{E'' r'' \sqrt{b''}}{f'' r'' \sqrt{b''} + q''(b'' + d'' + f'')\sqrt{a''}}$$

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* $\mu' = \dfrac{i}{i + l' + \rho'}$; $\lambda' = m' + \dfrac{f'}{f' + l' + d'} n'$

Dividing by q'', and putting $\frac{r''}{q''} = v''$ we have

$$A'' = E'' \frac{v'' \sqrt{b''}}{f'' v'' \sqrt{b''} + (b'' + d'' + f'' \sqrt{a''}}$$

This expression has a maximum* for

$$b'' = f'' + d''$$

which contradicts the regularity condition $f = b + d$ so long as d is different from zero.

Thus, in order to fulfil the regularity condition, and the maximum current, for the differential method simultaneously, we must put up

$$d = o$$

It has, however, been shewn that in order to have immediate balance, when adjusting balance by a variation in the resistances, we have to alter the resistances of the four branches $b + d$, $a + h$, f, and $w + \beta$ simultaneously according to a relation already given. Thus it is proved that adjustment of balance by an alteration of the resistances must be rejected, since, as pointed out before, a variation of the resistances of the coil b is impracticable.

We are obliged, therefore, to adjust balance by moving the coils or their armatures, and the further solution of the problem is only required, when this mode of adjustment is adopted.

Maximum magnetic moment.

It has now been proved that d is to be made zero, in order to be able to fulfil the conditions of *regularity* and *maximum current* simultaneously; and that therefore, to obtain immediate balance, readjustment of balance is to be effected by a movement of the two coils a and b or their armatures, and *not*, as has been generally proposed, by an alteration of the resistance in the branches $(a + h)$ and $(b + d)$.

Hence h appearing in the denominator of P only, and $h > o$ not being any more required for adjusting balance, the best value we can give to h is :—

$$h = o$$

which will make P, obviously largest.†

* In order to keep the balance in Station II rigid when b'' varies we must suppose v'' simultaneously variable with b''. This is perfectly justified, for v'' can be altered by an appropriate movement of the coils to keep up the balance in Station II without altering the outgoing current A''.

† The resistances d and h, without exerting magnetic force, were originally introduced in order to investigate the possibility of adjusting balance by an alteration of the resistances in the branches. But since it has been shown that this mode of adjustment is to be rejected it is of course clear that the dead resistances in these branches should be made zero when P will become largest.

Substituting therefore in the expression for P

$$h = d = o$$
$$f = w + \beta = b$$

we get

$$P' = \frac{E''}{2\,(a'' + c'') + b''}\,\mu'\,\lambda' \qquad \text{for Station I.}$$

and

$$P'' = \frac{E'}{2\,(a' + c') + b'}\,\mu''\,\lambda'' \qquad \text{,, Station II.}$$

These two expressions do not as yet contain the balance conditions.

The factors $\frac{\mu'}{2\,(a'' + c'') + b''}$ and $\frac{\mu'}{2\,(a' + c') + b'}$ are identical, namely :—

$$\frac{\mu'}{2\,(a'' + c'') + b''} = \frac{\mu''}{2\,(a' + c') + b'} = \frac{i}{Q}$$

Where $\quad Q = i\left\{2\,(a' + a'' + l' + l'') + b' + b''\right\} + \frac{b'\,b''}{2}$
$\qquad + (a'' + l'')\,(a' + l' + b') + (a' + l')\,(a'' + l'' + b'')$

as can be easily calculated by sustituting for μ and c their known values.

In the second investigation it has been stated why P' and P'' cannot be made maxima separately, and that we could do nothing else but make their sum a maximum. In this case we have to do the same. Hence the question to be solved is reduced to the following :

$$P = P' + P'' = i.\ \frac{E''\,\lambda' + E'\,\lambda''}{Q}$$

is to be made a maximum with respect to the variables a, b, q and r, while they are linked together by two condition equations, namely :—

$$r'\,(a' + c') - q'\sqrt{a'\,b'} = o \text{ balance in Station I}$$

and $\qquad r''\,(a'' + c'') - q''\sqrt{a''\,b''} = o \quad\text{,,}\qquad\text{,,}\quad \text{II}$

This general problem can be solved in exactly the same way as it was in the second investigation. It is however not needed to do this again, since the general solution can be written down from inference, after having solved the special problem for a line which is perfect in insulation.

Suppose that $i = \infty$, or at least very large as compared with $l' + l' = L$, then obviously P' and P'' become identical without condition, namely :—

$$P' = P'' = P = \frac{E}{4}\,\frac{2\,q\sqrt{a} + r\sqrt{b}}{L + 2\,a + b}$$

while the two balance equations become also identical namely :—

$$2\,q\sqrt{a\;b} - r\,(4\,a + b + 2\,L) = o$$

If we substitute the value of r from the balance equation in the expression for P, we get

$$P = E\,q \cdot \frac{\sqrt{a}}{4\,a + 2\,L + b}$$

which has an absolute maximum with respect to a only, namely

$$a = \frac{L}{2} + \frac{b}{4}$$

Substituting this value of a in the last expression for P we get :

$$P = \frac{E\,q}{4} \cdot \frac{1}{\sqrt{2\,L + b}}$$

Whence it follows that P becomes largest for $b = o$, otherwise b remains indeterminate; q on the other hand should be made as large as possible.

If we now put $v = \frac{r}{q'}$ and develope its value from the balance equation, we get

$$v = \frac{r}{q} = \frac{1}{2}\sqrt{\frac{b}{2\,L + b}}$$

The solution of the 1st problem of the differential method, when the line is perfect in insulation, is therefore

$$h = d = o$$

$$f = b = w + \beta$$

$$a = \frac{L}{2} + \frac{b}{4}$$

$$v = \frac{1}{2}\sqrt{\frac{b}{2\,L + b}}$$

The absolute value of b is left indeterminate,* and we only know that the smaller it can be made the better.

But to fulfil this best condition $f = b = w + \beta = o$ represents a physical impossibility, since neither β, the internal resistance of constant galvanic cells, can be made zero, not even approximately, nor b, which must have convolutions in order to act magnetically.

The larger $f = b = w + \beta$ becomes, for practical reasons, the more the differential method, even under the best quantitative arrangements as given above, will become inefficient as compared with the double balance.

* Practically, however, it may be said, that b is given; for generally β, the internal resistance of the signalling battery is determined by the nature and number of galvanic cells required for duplex working. We must only remember that b should be made somewhat larger than β, in order to have an adjustable resistance w in the battery branch, which may be used for compensating any variation of the battery resistance, that the equation $f = b = w + \beta$ may be permanently fulfilled.

Now by inference we get for a line with leakage, *i. e*, $i < \infty$

$$\left.\begin{aligned} a' &= \frac{L'}{2} + \frac{b'}{4} \\ a'' &= \frac{L''}{2} + \frac{b''}{4} \\ v' &= \frac{1}{2}\sqrt{\frac{b'}{2\,L' + b'}} \\ v'' &= \frac{1}{2}\sqrt{\frac{b''}{2\,L'' + b''}} \end{aligned}\right\}\text{Approximately.}$$

The above values for a and v are somewhat too large, but in practical application they are quite correct enough.

The physical reason that this solution for the differential method gives an indeterminate result, is simply due to the fact that the force which produces the signals in the differential method is due to the combined magnetic actions of *two* separate coils through which unequal currents pass, instead of to *one* coil, as in the bridge method. On account of $b = f$, it follows that the current which passes through the b coil is only half of that passing through the a coil. Thus, in order to make the most of the arrived currents, b and f should be both equal to zero, or, in other words, placing *all* the convolutions in a and *none* in b must clearly give the greatest magnetic force. Obviously, however, such a solution could not fulfil the balance condition in the sending station.

The value of b should be chosen as small as practicable and its minimum value is β, the internal resistance of the signalling battery. How much larger b should be taken, depends on the absolute variation of β, *i. e.*, on the constancy of the resistance of the signalling battery. If the battery is very constant with respect to internal resistance, then b need be only very little larger than β, which determines the adjustable resistance w.

For instance minotto cells can be easily prepared with an internal resistance of 10 B. A. U. per single cell. Their minimum resistance, obtained by working, is never less than 5 B. A. U., and if the zincs are changed from time to time, their maximum resistance will scarcely ever be higher then 10 B. A. U.

Hence to make b about 50% larger than β will suffice, by which, if β is known, the greatest value of w is fixed.

The absolute value of β can be determined from the number of cells which have to be connected up successively, in order to work a given instrument through a given line, when the circuit Fig. 2 is adopted. This absolute value of β will therefore not only depend on the electrical state of the line and the nature of the cells, but also on the absolute sensitiveness of the differential instrument employed.

To make β therefore as small as possible, a sensitive construction of the differential instrument becomes requisite; further cells of high E. M. F. and low constant resistance are best adapted for forming the signalling battery. In order to get the widest limits in the variation of w it is clear that *that* β should be selected which is calculated from the maximum number of cells required to produce the signals with sufficient force. The greatest number of cells is obviously required when the line is at its lowest insulation, in India during the monsoon.

The value $v = \frac{r}{q}$ is what has been termed the mechanical arrangement of the differential instrument.*

If $b = w + \beta$ has been determined by fixing β, then v has its smallest value for L largest, which is the case when the line is perfect in insulation; when the coil a must be closest to the magnetic pole acted upon, and the coil b furthest away from it.

The highest value of v we obtain by substituting the lowest L, *i. e.* when the line is at its lowest insulation; when the coil b must be nearest to the magnetic point acted upon, and the coil a furthest away from it.

Hence the two limits of v being fixed by the known limits between which L varies, the extent of movement of the two coils is also fixed, and consequently, if q is chosen arbitrarily, the construction of the differential instrument is determined. But even q is not quite arbitrary, since we know the form, dimensions and resistance of the coils, which, for instance, in Siemens' polarized relays on any given line, have to produce the magnetism in single circuit to get the signals with engineering safety.

The solution of the 1st problem of the differential method is therefore:

1. Balance in each station must be obtained by a movement of the two acting coils or their armatures, either singly or better simultaneously in the same direction, and *not* by an alteration of the resistances in the branches.

2. If this mode of adjusting balance be adopted, then the solution is:

$$\mathbf{d} = \mathbf{h} = \mathbf{o}$$

$$\mathbf{f} = \mathbf{b} = \mathbf{w} + \beta$$

$$\mathbf{a} = \frac{\mathbf{L}}{2} + \frac{\mathbf{b}}{4}.$$

$$\mathbf{v} = \frac{\mathbf{r}}{\mathbf{q}} = \frac{1}{2}\sqrt{\frac{\mathbf{b}}{2\,\mathbf{L} + \mathbf{b}}}$$

It will now be clear that the given solution fulfils the following essential conditions:

* J. A. S. B., Vol. XLI, Pt. II, p. 148.
Phil. Mag., Vol. XLIV, p. 166.

(i). *Any variation of the resistance in the total system has the least possible disturbing effect on the receiving instrument.*

(ii). *Any disturbance of balance can be eliminated by an appropriate movement of the two acting coils or their armatures, without disturbing balance in the distant station.*

(iii). *Conditional maximum magnetic moment of the receiving instrument.*

(iv). *Conditional maximum current.*

Addendum I.

Here I wish to give some additional explanations and corrections with reference to the 1st and 2nd parts of this investigation.

In J. A. S. B., Vol. XLIII, 1874, Pt. II, p. 20, I have substituted

$$c' = L' + \rho''$$

without stating that this expression for c' is only approximately true. The correct expression for c' is clearly

$$c' = l' + \frac{i\,(l'' + \rho'')}{i + l'' + \rho''}$$

which approximates closely towards $L' + \rho''$ if $l'' + \rho''$ is sufficiently small as compared with i. This for any line in good electrical condition, will always be the case.

At page 9, in the foot note, for "*as nearly as possible equal*" read "*as nearly as possible proportional.*"

At page 20, $$\frac{dG}{dg} = L\,(a^2 - g^2) + 2\,a\,g\,(d - g) = o$$

should be $$\frac{dG}{dg} = L\,(a^2 - g^2) + 2\,a\,(a\,d - g^2) = o$$

At pages 19 and 224 after having shewn that

$$a + f = g + d$$

I conclude at once that on account of equation VI ($a\,d - g\,f = o$)

$$a = g = d = f \qquad \ldots \qquad \ldots \qquad \ldots \quad \text{VIII}$$

while mathematically it follows only that

$$a = g$$

and $$d = f$$

These two equalities do certainly not contradict equation VIII but they do not necessitate it.

The additional reason why equation VIII should be chosen follows from the balance condition

$$a\,d - b\,c = o$$

$$\therefore \qquad b = \frac{a\,d}{c}$$

Therefore b becomes largest for any given c and any given $(a + d)$, if we put $a = d$.

But b largest is required for two separate reasons:

1. If the immediate balance is disturbed by an alteration of the resistance of one or more of the four branches, which may happen, especially by f, *i. e.*, β (battery resistance) varying, then ρ becomes at once a function of b, *i e.*, an increasing one with b. Thus in order to keep ρ as large as possible, and at the same time as constant as possible, b should be selected largest.

2. Further by making b as large as the circumstances will admit, we clearly have the largest sent and largest received currents, which will be clear without calculation. In fact later on, page 232, it has been shewn that $a = d$ is the condition for the maximum signalling current.

Addendum II.

Since the 3rd February, 1875, the main line from Bombay to Madras had been successfully worked duplicé by means of the "double balance method."

This line is worked direct, *i. e.*, without any translating instruments, and is 797 miles in length; it consists almost throughout of No. $5\frac{1}{2}$ wire B. W. G. (diameter $5\frac{1}{4}$ m. m.) and is supported chiefly on the Prussian insulator.

The section of this line from Bombay to Callian is exposed to the destructive influence of a tropical sea climate; between Callian and Poona the line passes over the Western Ghâts, the dense fogs during the cold weather and the heavy rains during the South-west monsoon on these hills seriously affect its insulation; from Poona to Sholapore and Bellary, the line runs inland and experiences a climate on the whole favourable for the maintenance of constant and high insulation; between Bellary and Madras, however, the line again comes under the influence of a most unfavourable climate, especially just before and during the continuation of the North-east monsoon, when the atmosphere at a high temperature, is saturated with moisture and salt, leaving conducting deposits on the surface of the insulators.

Consequently during the South-west monsoon the resultant fault is near Bombay, during the hot weather it shifts towards the middle of the line, and in November when the rains set in at Madras and the weather on the Bombay side is clearing up, the resultant fault is situated close to Madras.

By February next, duplex working will therefore have been submitted to a most severe test, applied as it will have been for a whole year to a long line the electrical condition of which is highly variable with respect to season and locality, and its practicability will doubtless again be clearly proved, as has already been the case on the Calcutta-Bombay line, 1600 miles, where under no more favourable climatic conditions, duplex has, for the past twelve months not only fulfilled but surpassed the expectations formed of it. No difficulties have been experienced, and it is believed never will be.

Strange as it may appear from a theoretical point of view, it will nevertheless be found in practice, that a line worked duplicé carries more than double the traffic of the same line worked singly; for it represents two lines carried on different posts far distant from one another, instead of 2 parallel lines on the same posts, and consequently the highly injurious effects of voltaic induction are eliminated.

Further the receiving signallers, not being provided with keys, are unable to interfere with messages during their transmission.

Corrections and repetitions do not necessitate a stoppage of work, for they are obtained in the following manner: the receiving signaller marks with a cross, or underlines the words to be repeated, and places the message by the side of the sending signaller, who calls for the repetitions directly he has finished the message he is transmitting, and during this call the distant station may either send fresh messages or may also call for repetitions; consequently single working need never be resorted to, and the simultaneous exchange of messages and corrections becomes continuous.

The Indian system of receiving (the sounder system which has now been universally recognised as the only right one hand for signalling) thus necessitates constant attention on the part of the receiving signallers, for any inattention on their part at once becomes known to the controlling officer.

X.—*Photography in connection with the Observation of the Transit of Venus at Roorkee, December 9th (Civil),* 1874.—*By Captain* J. WATERHOUSE, *Assistant Surveyor General of India.*

(Received July 30th;—Read August 4th, 1875.)

In December last I communicated to the Society a brief account of the proposed arrangements for observing the Transit of Venus at Roorkee, drawn up by Capt. W. M. Campbell, R. E., and although the popular interest in the subject has now somewhat worn off, a description of the operations connected with the application of photography to the observation in India of this very important astronomical event may not be without interest to the members of the Society, and as a record of experience gained, be useful on a future occasion.

Object of Photographic Observations.—Without entering into the consideration of the astronomical problems involved, it may be briefly stated that the object in view in making photographic observations of the Transit of Venus was to obtain a series of images showing, with the utmost attainable accuracy, the exact relative positions of the planet and the sun at carefully noted times during the progress of the Transit at the different stations of observation; so that by combining these photographs, the path of the planet across the solar disc might be accurately determined and the solar parallax be estimated by comparing the paths thus deduced for different stations. It was further proposed to endeavour to secure a graphic time-record of the exact moments at which the internal contacts of the planet and the limb of the sun took place, by means of an arrangement enabling a large number of photographic pictures to be taken on a single plate at intervals of a second or so just about the time of contact. It was anticipated that results of the highest possible value and reliability would be obtained if photographs sufficiently exact to allow of minute micrometrical measurement could be secured, as such photographs would form a permanent and indisputable record, entirely free from the errors and imperfections inseparable from personal observation, and have the further advantage that they might be examined at leisure and, if necessary, carefully compared by several independent examiners. How far these anticipations have been fulfilled still remains to be seen; but as several hundred photographs have been obtained in various parts of the world by different photographic processes and with dissimilar instruments, sufficient data will probably have been gained to test the value of photography for observations of so delicate a nature and, if this is satisfactorily proved, to show by what methods it may most successfully be applied.

The superintendence of the official arrangements for the observation of the Transit in Northern India was entrusted to Colonel Tennant, R. E., who has done so much to further the progress of astronomy and solar physics in this country, and was one of the first to recognise the value of photography as a means of recording the Transit. He selected Roorkee in the N. W. Provinces as his station of observation, partly on account of the great advantages to be gained by the proximity of the Canal Workshops for setting up the observatory and the repair and adjustment of instruments.

Photoheliograph.—It was arranged that photographic observations should form part of Colonel Tennant's programme and that with this object he should be furnished with a photoheliograph by Dallmeyer, of the same construction as those supplied to the English and Russian expeditions. These instruments were on the same principle as the photoheliograph designed by Dr. Warren De la Rue for the Kew Observatory, and consisted of a telescope combined with a photographic camera, equatorially mounted, and driven by clockwork. According to a description given by the maker, the object glass was 4 in. diameter and 60 in. focal length, corrected to combine the chemical and visual foci. The image of the sun formed at the principal focus was about ½ in. in diameter and was thrown on to an enlarging combination by which an enlarged image about 4 in. diameter was projected on to the sensitive photographic plate arranged as in an ordinary camera. A little in front of the enlarging lens was a slide pierced with two circular openings, one fitted with spider-web crosslines and the other with a glass plate ruled with a fine reticule of squares, and capable of adjustment so as to be brought into the focus of the object-glass in order that the cross-wires and reticule might be enlarged and brought to fine focus at the same time as the image of the sun. The pictures could thus be taken with the cross-wires, which served as a reference mark for measurements in connection with the declination and right ascension circles, or with the reticule, by means of which any optical distortion caused by the secondary enlargement of the image could be measured.

The quick exposure of the plates was effected by means of a shutter sliding between the cross-wires and the enlarging lens, in which position the object could be effected with a minimum of motion. This shutter was held at its lower end by a spring and was arranged so that when raised to its full extent, by means of a string attached to its upper end, the passage of the solar rays to the sensitive plate was cut off. This string passed over a pulley on the body of the instrument and had at the end a hook on which a loop of strong cotton thread was attached and, being stretched so as to pass over a conical block fixed on the camera, retained the shutter in its raised position. When the thread was cut, the force of the spring imme-

diately drew down the shutter and allowed a momentary exposure of the sensitive plate to the solar rays during the passage of a slit in the shutter, the width of which could be increased or diminished at will from nil to ·5 of an inch by means of another slide worked by a screw connected with a graduated scale. The rapidity of motion of the shutter could also be regulated by increasing or diminishing the tension of the spring by means of a screw.

When the shutter was down the solar rays were quite cut off; but by a simple arrangement a circular aperture above the exposing slot could be brought into a position concentric with the axis of the telescope, thus permitting the whole bundle of rays to pass uninterruptedly through the camera and enabling the image to be examined for focussing, &c.

The camera of the photoheliograph was constructed to take plates six inches square. The position of the image on the plates was regulated by means of a finder fixed on the outside of the telescope tube and consisting of a lens throwing an image of the sun upon a screen made of talc covered with paper, and adjusted so that when the enlarged image was in its proper position on the ground glass of the camera the finder image just filled a square ruled on the talc screen.*

Janssen Slide.—A repeating arrangement for taking several pictures on one plate, designed by Dr. Warren De la Rue on the principle proposed by the eminent French astronomer M. Janssen, and known as the Janssen slide, also formed part of the equipment. This arrangement having been fully described and figured by Dr. De la Rue,† it will suffice to say that it consists of a circular wooden case about 12 in. in diameter and 2 in. deep, with a removable shutter in front and constructed so as to be fitted on to the camera in the position occupied by an ordinary dark slide. Revolving on a central axis within this case is a metal disc or plate-holder, with 60 radial slots and as many circular spaces racked in its edge, carrying the sensitive plate held between rings strongly electroplated with silver. Outside the case, in front, a second smaller disc revolves just outside the shutter and is provided with a radial opening capable of being opened or closed at pleasure, so as to regulate the exposure by admitting more or less light to the plate through a radial slit cut in the shutter of the slide, about 1 in. long and exactly corresponding in position and width to the sixtieth part of the circumference of the plate. The axis of this exposing disc passes through the case and carries a pin which fits into the slots in the edge of the revolving plate-holder and is turned, from outside the case, by means of a winch arranged with gearing, so that it may be

* The screen originally supplied with the instrument was of parchment, but as this was found to expand and contract with the variations of moisture in the air, it was advantageously replaced by the talc and paper screen.

† Roy. Ast. Soc. Monthly Notices, May 1874.

worked either by hand or automatically by means of clockwork. This axis also carries an ivory ring on the periphery of which is fixed a piece of platinum wire which, as the axis revolves, comes into contact with a strip of platinum fixed on a spring attached to a connector, so that it may be placed in electrical communication with a chronograph and electric clock and thus enable the precise moment to be recorded, when the uncovering of the aperture in the shutter of the slide by the exposing disc exposes a portion of the plate to the sun. As there are sixty slots and the aperture corresponds to the sixtieth part of the circumference of the plate, it is evident that for each entire revolution of the plate-holder sixty distinct images will be impressed on as many separate portions of the plate within an annular space about 1 in. wide round its circumference.

The apparatus is constructed so that the plane of the sensitive collodion film shall exactly coincide with that of the focussing screen of the camera, and in order to adjust the instrument so as to obtain an image of any desired portion of the solar limb or disc, it is arranged that when the sensitive plate is in the proper position for receiving the first image of the sixty, the observer can look from behind, through a series of three red glasses, one of which is in front of the plate, on the exposing disc, and the other two behind it, one on the revolving plate-holder and the other on the wooden case. The three glasses are coincident only in one position, *i. e.*, when the stop, formed by racking the last of the radial slots for only a short distance, is on the right of the axis; and as the stop is on the left of the axis after a complete revolution, the revolving plate-holder must always be reversed through an entire revolution after each operation in order to bring it into the proper position for focussing. While focussing, the sensitive plate itself acts as a focussing screen.

By means of clockwork the rate of revolution of the plate-holder could be so adjusted that the exposures might be made at intervals varying from about half a second to two seconds, but as it was desirable not to expose the separate pictures too rapidly, the rate was set so that the entire revolution might be accomplished in about a minute and a half.

Preliminary trials with Dry Plates.—I received intimation about the middle of August 1874 that, with the concurrence of the Surveyor General, my services were likely to be placed at Colonel Tennant's disposal for the superintendence of the photographic observations. As there appeared to be a general opinion in Europe that a dry process would be most suitable for continuous observations lasting over a period of some hours and would have other special advantages for the purpose, the first thing to be done was to select the process to be used and to gain some experience in working it; and although the weather at that time of the year was most unfavorable to photography and very trying to work in, all the time that could be

spared from my regular office duties was devoted to preliminary trials of dry plates in Calcutta till October, when I joined Colonel Tennant at Roorkee.

It was understood that the English observers were to use the beer-albumen dry process recommended by Captain Abney, R. E., and therefore my first trials were with it; but although the instructions given by Captain Abney were carefully carried out, it was found impossible to obtain the exalted sensitiveness claimed for the plates and, though the pictures obtained had many good qualities, the exposures were so long that I could not but consider the process unsuitable and look for some other by which more sensitive plates could be secured. The beer-albumen process was, however, tried on several different occasions, both in Calcutta and at Roorkee, with different collodions and various samples of beer, but always with the same result.

The cause of the great want of sensitiveness shewn by these plates could not be discovered. Captain Abney says that those who have not succeeded with his process have not used a sufficiently porous collodion ; but on this occasion several collodions were used, some containing a large proportion of water, but without any noticeable advantage ; though other dry plates taken with the same collodions gave much greater sensitiveness.*

It is possible that the beer used was not quite suitable from containing too large a quantity of chlorides or other substances detrimental to sensitiveness, and that this was probably the case is shown by the fact that a much greater sensitiveness and generally better results were obtained with the mode of working the beer-albumen process recommended by Mr. Davies of Edinburgh, in which a small quantity of nitrate of silver is added to the beer with the effect of throwing down all the chlorides and much of a glutinous substance; but even this modification did not give quite satisfactory results and the idea of using the beer-albumen process for the Transit plates was given up. Although the process has no doubt yielded excellent results in the skilled hands of Captain Abney and others, the uncertain composition of the different liquids known as beer render it undesirable that this substance should be used in the preparation of dry plates which are to serve as a standard for scientific purposes and from which comparable results are expected. For such purposes more certainty and

* I have quite recently tried the beer-albumen process again with samples of collodion yielding good results with other dry processes—but found the plates just as insensitive as they were before. By flowing the films, after washing away the free silver, with a 10-grain solution of pyrogallic acid in beer, then again well washing, and finally flowing the plate with a mixture of glycerine and dilute albumen, plates were obtained giving excellent results with at least ten times more sensitiveness than those prepared by Captain Abney's plan.

uniformity will be attained by the use of materials which are likely to be of nearly the same chemical composition in all parts of the world.

As the beer-albumen process was not found to answer, attention was turned to other dry processes and several different methods were tried with varying results.

At an early stage of the experiments it was found from trials with a rough photoheliograph, constructed in Calcutta for the purpose, that a process which might give very good results for taking views &c. would not answer for the sun and *vice versâ;* and the same was afterwards found to be the case when working with the English photoheliograph.

Among the most promising dry processes tried in these preliminary experiments were the gum-gallic, in which the so-called preservative is composed of a solution of gum arabic and gallic acid, and a process in which the preservative was laudanum, either alone, as a dilute solution in water containing from 16 to 4 per cent. of laudanum, or mixed with gum arabic or gum tragacanth, in order to keep the pictures free from the stains liable to occur when using the laudanum alone. Excellent results for views were also obtained with a filtered mixture of laudanum and very thin arrowroot water. I was induced to use the laudanum from a statement of Prof. Vogel of Berlin, that plates prepared with morphia were more sensitive to the comparatively nonactinic rays from the outer part of the solar disc; and though I did not remark any special superiority in this respect, the laudanum plates were found more sensitive than most of the others tried. Plates prepared with a saturated solution of morphia in water also gave good results.

The addition of nitrate of uranium to the nitrate of silver bath used for sensitising the plates, as recommended by Captain Abney, was found advantageous for most of the dry plates, giving increased sensitiveness and other good qualities. As some doubt has lately been thrown on the advantage of the uranium bath, it may be as well to state that in the ordinary wet process with bromo-iodised collodion I have found that no advantage is gained by the addition of the uranium salt to the nitrate bath, but, on the contrary, there is a great loss of sensitiveness. With dry plates, however, it is different, the gain in sensitiveness is well-marked and the shadows appear cleaner than on plates sensitised in the ordinary bath without the uranium.

Shrinkage of the Collodion films.—When it was first proposed to employ photography in observing the Transit, it was objected that the collodion processes would be unsuitable on account of the shrinkage or contraction the collodion films undergo in drying. De la Rue in 1861 made some very careful experiments, the result of which was to shew that with proper precautions the shrinkage was entirely in the thickness of

the collodion film: more recently, however, Paschen had found this contraction to amount to not less than $\frac{1}{1856}$ of the length of the plate with albumenised plates, and to $\frac{1}{2128}$ of unalbumenised plates; in one instance it being so much as $\frac{1}{523}$ of the length and $\frac{1}{618}$ of the breadth of the albumenised plate. Rutherfurd, on the other hand, found that if the plates received a preliminary coating of albumen, the shrinkage of the wet film in drying did not exceed $\frac{1}{4800}''$ and was, on an average, about five times less. Prof. H. Vogel, of Berlin, also made some experiments on the conditions affecting the stability of the collodion film, which proved the value of a substratum as a preventive of contraction of the film and shewed that dry plates were less liable to contraction than wet. Captain Abney and Colonel Stuart Wortley, when experimenting on a dry process to be used for the transit by the English expeditions, also gave this subject their careful consideration and came to the conclusion that with proper precautions the amount of shrinkage would be so small as to be negligible. Notwithstanding this concurrence of testimony as to the possibility of disregarding the contraction of the film, I thought it desirable to satisfy myself as to the suitability in this respect of the various dry processes I was trying, and the plates were therefore tested by a method which I afterwards found was somewhat similar to that followed by Dr. De la Rue, and appeared to have the advantage of entirely avoiding any chance of error from parallax caused by want of absolute contact between the test lines and the collodion film. Several glass plates five inches square were prepared by drawing on them, with a very fine diamond point, diagonal lines through the corners of the plates. With the intersection of the diagonals as a centre, a circle was described 4 in. in diameter, so that it might correspond in size with the solar disc on the plates to be taken during the Transit. These test plates were then coated with the usual albumen substratum and prepared exactly in the same way as the dry plates under trial. They were exposed to light from the back, so that an impression of the engraved lines was obtained through the film. The plates were then developed in the same way as the other plates and when dry, examined under a very powerful micrometer capable of dividing to the $\frac{1}{100000}$ of an inch. To facilitate the examination, a piece of the film was cut away across the lines in different parts of the plate, and the course of the uncovered part of the line compared with the covered part. In no case was any perceptible difference found, except when the substratum had been purposely omitted, or processes used which gave rise to blistering of the film. The only chance of error I could see in this plan was the sticking of the film to the rough surface of the engraved lines; but in the cases where the film blistered it was found that the blistering was more marked on the lines than elsewhere, and so it would appear that the lines did not exert any particular influence on the free motion of the film. I had not

time to go into the subject very thoroughly nor the means of trying other tests.

Arrangements of the Observatory.—I arrived at Roorkee on the 13th October and thus had about eight weeks for preparation. Colonel Tennant had built an observatory with domes for all the observing instruments and had allotted to me a very convenient dark room about ten feet square, attached to the dome in which the photoheliograph had been erected and separated from it by a narrow passage about 7 feet long and 3 feet wide. I had doors placed at each end of this passage, so that communication could pass between the dome and the dark room without letting light into the latter; and in order to avoid the necessity of constantly opening the doors for the passage of the dark slides to and fro, a sort of box opening at both ends and large enough to hold a dark slide was let into the panelling of each of the doors, and the dark slides were thus easily passed backwards and forwards without any risk of letting in light or raising of dust. Double doors were also constructed at the entrance to provide for communication from outside without interruption of the work going on within. Tables and shelves were arranged in the dark room so as to keep all the operations and the necessary chemicals and appliances for each quite distinct; thus there was a table for the nitrate baths and near it, shelves for the collodions and plate boxes. Another table with sink, was set apart for developing and close by, were shelves for the developers and chemicals &c. used for developing. A third table was used for changing dry plates and above it were shelves for the dry plate boxes. Some such system was absolutely necessary in such important operations, and the principle of a place for every thing and every thing in its place was rigidly adhered to.

As it was undesirable to use the dark room in the observatory for the preparation of plates and chemicals or as a store room, nothing was kept in it except the chemicals and apparatus actually required there. A dark room for the preparation of dry plates, testing baths, &c., was fitted up in a house immediately opposite the observatory, and here also all mixing of chemicals, cleaning plates, and other preparatory work was carried on and spare stores kept.

The photoheliograph had been erected by Colonel Tennant before my arrival on an isolated brick pillar in the centre of a circular room 12 feet in diameter, fitted with a revolving observatory dome.

It was arranged that the times at which the several photographs were exposed should be recorded by electricity on a chronograph placed in an adjoining room in electric communication with the standard clock, which also gave the time to a clock-dial placed in the dome.

This was effected by the use of a tappet or make-circuit key, to which Colonel Tennant had very ingeniously fitted a pair of scissors so that the act of cutting the thread to let loose the exposing shutter of the photoheliograph, completed the circuit and the exact time of exposure was thus instantaneously recorded on the chronograph. The Janssen slide was also fitted with arrangements for being placed in electric communication with the chronograph, so that every turn of the winch was recorded at the moment of exposing each picture round the circumference of the plate.

The staff of assistants at my disposal included three European assistant-photographers, Sergeant J. Harrold, R. E., of the Photographic Branch Surveyor General's Office, Calcutta, Lance-Corporal George and Private Fox, of H. M.'s 55th Regiment, who had been thoroughly trained by Colonel Tennant in the ordinary manipulations of the wet collodion process, with three native servants for handing the plates to and fro and performing other menial duties.

Preparatory Work and Drills.—One of the first things to be done before beginning the drills was to examine the whole stock of glass and carefully select about 200 of the best and most free from flaws, which were carefully set aside to be used for the Transit.

The dry plate trials were resumed with the advantage of having a suitable instrument to work with. The beer-albumen and other processes that had been found more promising in Calcutta were tried again, but were found not quite satisfactory with the sun; the tea and coffee processes, which I had not tried in Calcutta, were better and I finally adopted a modification of the coffee process recommended by M. Constant of Lausanne, substituting albumen for gum to avoid the tendency to blistering so common when using gum, and also with the view of lessening photographic irradiation, against which the coffee proved a further protection. These plates were easily prepared and were found fairly sensitive, easily intensified, perfectly clear and free from blurring in the shadows.

The glass plates, having received a thin coating of albumen as a substratum, were coated with collodion and sensitised by a somewhat prolonged immersion in a 40-grain silver bath, then washed in four changes of distilled water and finally immersed in a resensitising solution, or so-called preservative, composed of

Dried albumen	2 grammes
Sugar	12 „
Coffee infusion made by boiling 30 grammes of coffee in 360 C. C. of water	300 cub. cents.
Water..	300 „ „

and then drained and dried without heat.

As soon as arrangements were sufficiently advanced, preliminary drills were commenced with the object of finding out the best mode of working, in the event of dry plates being used, and after a few trials, it was arranged that instead of developing every twelfth dry plate, as proposed by the English observers, every fifth plate should be prepared by the wet process and developed at once to ascertain if all the adjustments were correct, the necessary alterations in the exposure of the plates being arranged by trials beforehand.

From some cause all the dry plates prepared at Roorkee were covered with spots, some transparent, others opaque and comet-like, and as it was impossible to trace the cause of these spots or to avoid them, even with the most careful precautions, trials were made, about the 17th November, to ascertain if the ordinary wet process could be used instead and, after working a few days, it was found that there was no difficulty in keeping a regular supply of plates every two minutes by the use of four sensitising baths. The superior convenience of working by the wet-plate system and the great saving of time and trouble that would be gained became so manifest that it was definitely decided to adopt it and thenceforth the wet plate drills were carried on daily between the hours of 7 and 12, during which the Transit would take place; as a rule in the early morning and forenoon, alternately, sometimes twice during the same day. Particular attention was given to practising the mounting of the Janssen slide by signal and again unmounting it and resuming the ordinary plates in the interval.

Although the use of dry plates was said to possess the great advantage of enabling irradiation to be much diminished by the use of albumen in the re-sensitizer and also in reducing the shrinkage of the film to a mininum; as well as great convenience in preparing and developing the plates at leisure free from excitement or hurry, and in facilitating the working of a large number of plates with a small staff of assistants, the substitution of the wet process had many advantages in avoiding the very tedious operations of preparing and developing so large a number of plates, which alone would have taken up about two days before and after the Transit, and more particularly in enabling the state of the work to be seen throughout the Transit and any necessary alterations to be carried out immediately. The manipulations of the wet process were perfectly familiar to all my assistants and by a division of labour they were able to carry on the work with ease and without the slightest confusion.

By giving the films a substratum I hoped to avoid any shrinkage of the collodion in drying and by placing pieces of wet red blotting paper behind the plates to lessen the tendency to irradiation.

My programme of operations having been drawn up and approved by Colonel Tennant, the first rehearsal took place on the 28th November with tolerable success, and several points were noticed as requiring modification.

After further practice, a second full rehearsal took place on the 2nd December, and a final one on the 6th, which was very successful; 120 six-inch plates with 6 Janssens being exposed in the course of the time the Transit was calculated to last.

The preparations for the Transit itself, such as numbering and cleaning glasses, preparing and testing baths, and examining the minor adjustments of the instruments were commenced about a week beforehand.

Unfortunately the weather for a few days before the Transit was very cloudy and most unfavorable for trials of chemicals and testing the focal adjustments of the instrument, which caused some trouble and uncertainty.

Although it was determined to adopt the wet process entirely for the Transit plates it was considered desirable to have a small supply of dry plates prepared in reserve in case of accidents and to be used, if necessary, at times when the supply of wet plates could not readily be kept up. About a dozen of the six-inch and four of the Janssen plates were therefore prepared by the coffee-albumen process, already described, using a highly bromized collodion recommended by Captain Abney for sun pictures, which gave an intense picture with considerable sensitiveness; but owing to the short time between receiving the materials from England and their being used this collodion had scarcely time to ripen properly, and so could not have a fair trial. Captain Abney's formula was—

Thomas' bromized collodion....................	20 oz.
„ iodized „	20 „
Alcohol s. g., 805..........................	6 to 8 „
Pyroxyline	300 grs.
Water	120 min.

The plates were developed with the strong alkaline developer recommended by Captain Abney.

One of these Janssen plates and four of the six-inch plates were used during the Transit and, with the exception of the spots, were excellent pictures, fairly sharp and dense, free from blurring, and, in some respects, better than many of the wet plates.

Several days before the Transit 120 six-inch glasses were selected from those set aside as the best and were numbered with a diamond in one corner consecutively from 1 to 120. A reserve of about 30 plates was also selected and marked with a cross in one corner. The whole of these plates as well as a dozen of the best circular Janssen plates were then carefully cleaned and coated, on the unmarked side, with an albumen substratum, consisting of the white of one egg and about one drachm of ammonia to a wine-bottle of water, in order to prevent any rising of the film and consequent liability to shrinkage. The plates thus numbered and albumenised were arranged in order in five boxes, hold-

ing two dozen each, with the marked corners running along the upper left hand side of the boxes. Each box was then legibly marked with a distinguishing letter and the numbers of the plates contained in it thus $\frac{\text{A}}{\text{1-24}}$. A sixth box containing marked plates was kept in reserve to be used if required, and it was arranged that any plates so used were to be numbered at the time of use with their proper number in order of sequence.

It was also carefully enjoined on the assistants that the utmost care was to be taken to preserve the proper order of sequence of the plates throughout the operations, but that if, by accident, a plate should be left out or any alteration in sequence occur, the officer in charge should be at once informed of it and duly record it. Should any of the plates originally numbered be broken during any of the operations or put aside from any other cause, their places were to be filled up from the marked plates and they were to be numbered in their proper order of sequence.

Arrangements were made for providing four nitrate of silver baths of suitable size for sensitising the six-inch plates and a larger one for the Janssen plates; besides these, two small baths and one large one were kept ready in reserve in case of one of the other baths getting out of order or becoming temporarily unfit for use. The baths used were new and about 45 grains to the ounce (10·2 per cent.).

The collodion used was prepared according to a formula given me by Colonel Tennant as follows:—

Cadmium Iodide, ...	1	gramme.
Cadmium Bromide, ...	1	,,
Ammonium Iodide, ...	1	,,
Pyroxyline, ...	4	,,
Ether, ...	110	cub. cents.
Alcohol, ...	110	,, ,,

This collodion contained a large proportion of pyroxyline and haloid salts and was selected because it was found to give more density of the film and intensity of image than the ordinary commercial samples. Two pints of it were carefully cleared for use during the Transit.

A reserve supply of a mixture of Thomas' and Rouch's was also used for some of the plates. It was arranged that the collodion should only be used once, so that each plate might be coated with fresh collodion, thus preserving the uniformity of the films and keeping the collodion free from impurities.

An ample supply of developer was also prepared by the following formula:—

Protosulphate of Iron........................	55	grammes
Sugar	55	,,

Glacial Acetic acid	40	cub. cents.	
Spirits of Wine..........................	30	,,	,,
Water	1000	,,	,,

A solution of cyanide of potassium was used for fixing.

It was considered advisable not to intensify the plates, but to obtain the greatest possible intensity from the first development.

As the plates were developed they were placed in a draining rack in order as taken and put aside till after the Transit.

The distribution of duties was arranged as follows:—

I remained at the Photoheliograph to expose the plates at every two minutes and record the times of exposing each plate by the clock dial, which had previously been ascertained to agree with the standard clock, carefully noting any variation in the intervals and any other noteworthy circumstance connected with any of the plates. At every sixth plate, with a few exceptions, the cross-wires were replaced by the reticule.

Sergt. Harrold developed the plates and generally supervised the operations in the dark-room. He was directed to take special care that the plates were arranged in the racks in their proper order of sequence as developed, and to note in writing any variations. He was at once to inform me of any defects in exposure or in the position of the image on the plate.

Corporal George coated the plates with collodion and sensitised them. He was responsible that the plates were taken in the proper order, as numbered and arranged in the boxes, and was ordered to at once report any change. In case of having to pass over any of the marked and numbered plates, he was to properly number the plates substituted for them. In order that the position of the sun's image might be the same on all the plates, he was ordered when coating the plates with collodion to keep the unnumbered side of the plate uppermost, with the numbered corner away from him on his right hand, pouring off the collodion at the near right-hand corner.

Private Fox took the plates out of the baths and placed them in the slide so that the numbers might be at the upper left-hand corner of the slides and the thick collodion at the lower left-hand corner. (This arrangement of the plates when being coated and placed in the slides was observed throughout all drills and practice plates, and answered the purpose perfectly.) He then placed the dark slides in the receptacle in the door from which they were passed into the dome by the man in the passage between the doors. It was also his duty to carry the Janssen slide into the dome, place on and take off the No. 1 counterpoise, which was fixed at the end of the declination axis, and carry the Janssen plates back again for development. In case of there being any delay in a wet plate being ready at the proper time, he was to keep a dry plate in readiness to be sent in instead, notify-

ing the change, and this he was ordered to do at all changes from wet to dry and *vice versâ.*

In order to prevent mistakes and confusion in communicating between the dome and the dark room, it was arranged that all communications should be in writing; supplies of slips of paper with a pencil attached were kept in a convenient position in different parts of the dark room and the dome, and were passed to and fro through the slides in the doors without noise or disturbance of the operations.

Of the three native servants, one remained in the dark room to hand the dark slides backwards and forwards, but when the Janssen slide was used he went into the dome to put on the No. 2 counterpoise, at the object glass end of the telescope; another man remained in the space between the double doors and passed the dark slides in and out through the slides in the doors. The third stood in the dome to hand me the dark slides, hold the loops of thread and hook them on the string attached to the exposing shutter, turn the dome, and give me any other assistance I required.

Corporal George and Private Fox took it in turns to act as orderly of the week and their duties were to open the dome for work, have the water boxes filled at the proper times, uncover the instrument, see that the necessary chemicals and glasses were ready in their places for use, and after work, to have the rooms cleaned, the instrument dusted, and the dome closed.

Two or three days before the Transit I examined all the adjustments of the sliding shutters and the electrical communications and satisfied myself that all were in good order.

As the weather had been cloudy two or three days before the Transit there was some uncertainty as to whether it would be fine or not, but, in the event of its turning out cloudy, I had arranged that the whole operations were to be gone through just as for a drill, so that we should have been in a position to take immediate advantage of any break in the clouds, discretion being of course exercised in altering the uniformity of the intervals between the plates, in order to take advantage of any passing gleam of clear sunshine. Fortunately it was fine and this precaution was not required, but I am sure that it was the only way of making certain of being ready at a moment's notice had the sky been cloudy.

Operations on the Day of the Transit.—After the cloudy weather of the previous two days, it was an agreeable surprise when we awoke on the morning of the Transit to find an almost cloudless sky. All preparations had been completed the night before and we were in our places betimes. As the first contact had been computed to occur at about 7h. 13m. 7s. (mean time) the order for commencing the preparation of the plates was given about 7 o'clock, and the work of the day commenced with the exposure of a Janssen plate for trial of the apparatus. After

this two six-inch plates were exposed and then, about bisection, another Janssen, followed by two more six-inch plates and then a third Janssen for the first internal contact, for the exposure of which a signal was to be given by Colonel Tennant. Owing to the wet plate prepared for this having slipped off the dipper, a dry plate was substituted and the plate was mounted in ample time. While watching the image carefully through the red glass, waiting for Colonel Tennant's signal, I noticed that the planet appeared to have passed well within the boundary of the solar disc, though still attached to the limb by a well and strongly defined ligament, so that the planet and ligament were of a distinct gourd-shape exactly like the appearance of the "black drop" one had been led to expect.* On development the plate showed no sign of any such such gourd-like appearance, except at the 21st picture where the clock-work had dragged, and there an image appeared, the exact counterpart of what I had seen.

After this the regular work with the six-inch plates commenced and went on pretty regularly, at the stated intervals of two minutes between each exposure, till about half-past 9, when there was a break of 15 minutes for refreshment and to change the chronograph paper, &c.

Though this break may appear long, it had been found more convenient to have one long break than two or three shorter ones, on account of the loss of time in stopping and getting under way again. It was arranged that the break should take place either well before or after mid-transit, so as to be sure of pictures being taken about the time of mid-transit.

It was also arranged that when the signal for the break was given, all wet plates under preparation should be exposed and dry plates sent in till all the wet plates had been developed and every thing was ready for opening out the doors. In the same manner after the break, dry plates were sent in until the wet plates were ready. The work then went on as before till the time came for mounting the Janssen for the second internal contact, which was exposed by signal from Colonel Tennant. Two more six-inch plates were then taken, then a Janssen, followed by two more six-inch plates, and last of all a Janssen, about the time of last contact, which was exposed and closed a few seconds before the final contact, thus concluding the work.

The sequence of the plates in the racks was examined and the plates were left to dry till next day and then replaced in the plate boxes.

It had originally been intended that 120 six-inch plates should be taken, as it had been found quite possible to do so at the rehearsals, but as I was perfectly dependent on Colonel Tennant's signals for starting the Janssen plates, I allowed plenty of time so as to make sure of having the

* Colonel Tennant remarks with reference to this—"There is no doubt in my mind that the outer part of the sun is *never* free from the result of outstanding astigmatism. For Janssen plates it should have been specially cared for at the expense of the central portion of the picture."

Janssen plates ready when required, without hurry; and so only two plates were taken between the Janssens instead of four, as had been arranged.

The result of the day's work was 109 six-inch plates taken, but of these two failed entirely, so that only 107 can be counted. These are all fairly clean and free from fog or stains but in many of the plates the images are not so sharp as could have been desired. Though the day was fine and cloudless, there was a good deal of haze and I think the want of sharpness is chiefly due to this and other atmospheric conditions, as the same faults were observed for two or three days after the Transit.

Of the Janssen plates there were five which also were, for the most part, clean, good plates, fairly well defined though not perfectly sharp.

Several of the photographs shew marked irradiation round the planet, and a want of sharpness which may be partly due to the atmosphere of the planet, as the limb of the sun is very much sharper. On some of the pictures distinct streamers are visible round the limb of the planet and proceeding from it. I have not seen anything of the kind mentioned as being observed by other parties, and, as the appearance is not visible on all the negatives, it is no doubt a form of photographic irradiation; but, if not, a comparison of the Roorkee negatives with those taken at other places may throw light on the cause of it.

None of the plates were varnished, as it was considered undesirable to varnish plates intended for future measurement, and also to obviate any chance of the varnished films cracking when removed to England, as is often the case with negatives taken in this country.

With the exception of the want of sharpness of some of the plates, the operations may be considered quite successful as far as the mere photography is concerned. The arrangements described above and the programme of operations answered admirably and I cannot suggest any improvement. Whether the photographs are sufficiently sharp and perfect in other respects to answer the purpose intended still remains to be seen.

General Remarks.—During the course of the preparations a good deal of time had to be devoted to putting some of the instruments into proper working order, in which work I was much assisted by Captain Campbell, who had charge of the operations with the great 36 in. theodolite. Thus for some time, the Janssen plates were found to be fogged and so indistinct as to be almost useless. This was due, partly to reflection of light from the polished surface of the wood-work of the slide and the brass-work of the under surface of the exposing disc, which was partially obviated by covering with dead black varnish all the surfaces capable of reflecting light on to the sensitive plate, and partly to the ruby-red glass fixed in the revolving disc not being perfectly impervious to the actinic rays, but this defect was overcome by substituting a piece of thick ruby-glass for the thin, light-coloured piece originally supplied. Even with these precautions, some white light found

its way on to the plate between the revolving disc and the wooden case, which were at a greater distance apart than appeared necessary, though the entrance of light might have been prevented by fitting the exposing disc with a flange running in a groove cut in the wood-work of the slide or fastened above it. There was also considerable friction about the internal surfaces, which caused a strain on the clock-work and gave a good deal of trouble till the cause had been removed. With the exception of these defects, the slide seemed admirably constructed and adapted for the object in view. It remains, however, to be seen how far this ingenious instrument has answered the expectations of its inventor and those who have adopted it, but if it should be used at the next Transit, it would, I think, be desirable that arrangements should be made for the automatic movement to be continued or distributed at intervals over a much longer period than one minute, as on the present occasion, so that all the phenomena attending the contact may be fully observed and recorded. It is also very desirable that the photographer should not require a skilled observer to watch the time of contact for him. The doing so has a very disturbing effect on a man who is able to make a good observation of contact, and time is also lost in preparing and waiting for a signal.

As far as shewn by the plates obtained at Roorkee the differences between pictures taken a few seconds apart are so slight, and the advance of the planet is so imperceptibly marked, if indeed, there is not sometimes an appearance of retrogression caused by atmospheric tremor, that perhaps little would be lost by taking the pictures at intervals of 4 or 5 seconds instead of at every second.

The mounting of the slide necessitates the alteration of the adjustments of the telescope for taking the six-inch plates, thus stopping all such observations about the critical period and it is therefore most desirable that each operation with the Janssen slide should extend over as long a period as possible. Colonel Tennant tells me that the cusp measures are indefinitely more valuable, if good, than any six-inch plates, which he would *entirely* eliminate. In this case, if it were considered essential that the successive pictures should be taken at intervals of not more than one or two seconds, a second, or even a third, Janssen slide might be provided so that they might be rapidly changed one after the other. If it were feasible to construct the slide so that the plates could easily be changed without removing the whole slide from the camera, it would be better still, as in that case the observations could be carried on at every second or two, and three or four plates exposed in quick succession during five or six minutes about the time of contact, and, if desirable, continued at regular intervals afterwards; but this appears to present considerable mechanical difficulties and an arrangement would be required by which the revolving disc could be at once brought into the proper position

for exposing the successive plates instead of having (as in the present slide) to be reversed through an *entire revolution*, which alone takes nearly half a minute.

The photoheliograph, like all work turned out by Mr. Dallmeyer, was an excellent and perfectly finished instrument, but seemed to me to be scarcely sufficiently firmly mounted for continuous work extending over so many hours, with the constant shaking caused by the insertion and withdrawal of the dark slides, which were much stiffer than they ought to have been. This stiffness of the dark slides was found not to be due to climatic influence, because they did not agree in measurement with the focussing screen which fitted perfectly, and they had to be filed down considerably before they would fit; this defect, due no doubt to an oversight in the maker or to hurry in turning out the instrument, was a serious one, as besides the liability to tremor caused by the frequent alteration of declination, the focus might have been disarranged by the alteration in the thickness of the slides by filing, but there was nothing else to be done under the circumstances.

For my part, speaking merely as a photographer, I should prefer the system adopted by Lord Lindsay and the American parties in which the camera was an immovable fixture and the solar image retained in a constant position by means of a siderostat carefully adjusted to follow the sun. In any case, the slides should be constructed to fit quite easily into their places, and in this respect the dark slides made for the equatorial camera used at Dodabetta for photographing the solar eclipse in 1871, were of a much better pattern than those sent out with the photoheliograph.

Another defect of the photoheliograph was that the hanging counterpoise, placed near the object-glass of the telescope when using the Janssen slide, was found to swing and induce a tremor in the instrument, spoiling the definition of the pictures; it was therefore replaced with a rough, but efficient substitute, in the shape of a canvas bag, the ends of which were filled with shot. This was merely hung over the end of the telescope at the proper balancing point and kept the tube perfectly steady.

As regards the process to be adopted for photographing the Transit of 1882 much will depend on the results obtained by the different methods used in December last as to whether photography can be advantageously employed and, if so, which process is most suitable.

As far as my experience goes, the wet process seems less favourable to perfect sharpness and clearness of the image than the dry, but Colonel Tennant tells me he has lately obtained very superior results by using a pyrogallic acid developer with bromoiodised collodion, in place of the iron development. From experience I have gained in preparing for photographing the recent Eclipse, I believe that great advantages may be obtained by slightly staining the ordinary wet films with orange or red anilin dyes or

by the use of *moist* plates, prepared with bromised or bromoiodised collodion afterwards treated with albumen and glycerine, which I have found very simple to prepare and exceedingly free from all tendency to blurring or irradiation. It is probable, however, that before 1882 the usual modes now in vogue for taking negatives will have been quite superseded by the simpler method of using sensitive emulsions which have only to be poured on to the plates and dried without any further preparation. Great advances have recently been made by Carey Lea, Bolton and others in obtaining such emulsions capable of giving pictures with the same rapidity as the ordinary wet or dry processes and with a perfect freedom from the irradiation or blurring so detrimental in astronomical photography, besides which the perfect simplicity and ease of the operations are a strong recommendation; and I may, I think, safely predict that should photography be used for the next Transit, the emulsion processes will, if not exclusively, be used very extensively; unless, possibly, the superiority of pictures taken on daguerreotype plates or silvered glass films over those on collodion should be incontestably proved or some other better process be discovered meanwhile.

Although the photographic operations connected with the observation of a Transit of Venus present no great difficulties, and are in some respects easier than photographing the total phase of an Eclipse, a great deal of patient careful work is required beforehand to ascertain the best conditions for working with regard to local circumstances, and this the short time at my disposal on the present occasion scarcely allowed me to have, especially as so much time was spent over the dry process, which might, as the event proved, have been well employed in perfecting the wet. It is therefore very desirable that the subject should not be lost sight of between this and the next Transit and that every opportunity should be taken of utilising the experience already gained towards ascertaining the most perfect methods of taking these sun-pictures. It would also be advisable that as many as possible of the observers of the last Transit should also take part in the next.

Although the Transit of 1882 will not be visible in any part of India, much useful preparatory photographic work might be done concurrently with the daily observations of sunspots, now that an instrument is available for taking advantage of the comparatively fine weather enjoyed in this country, particularly at the time of year when the weather in Europe is most unfavourable to such observations; and this would not be the least among the many advantages to Science to be gained by the establishment of a Solar Observatory in this country, which has been so earnestly advocated by Col. Tennant and, it is to be hoped, will soon be an accomplished fact.

XI.—*Descriptions of new Marine* Mollusca *from the Indian Ocean.* *By* G. *and* H. Nevill.

(Received July 15th;—Read August 4th, 1875.)

(With Plates VII and VIII.)

The types of the new species of shells described in this paper mostly belong to the family *Pleurotomidæ,* and are all in the collection of the Indian Museum.

Murex (Ocinebra) gibba, Pse.

Latirus gibbus, Pease, Am. J. Conch., 1867, (*Sandwich I.*)
Murex Crosseana, Lién., J. de Conch., 1874, (*Mauritius*).

We have found this shell at Ceylon, the Seychelle, and Andaman Islands; it is nowhere a common shell.

Murex (Ocinebra) fiscellum, Ch. var.

Chemn., Conch. Cab., fig. 1524-5, (*Pulo Condor*).
M. Liénardi, Crosse, J. de Conch., 1868, (*Mauritius*).

We have found both the type form and the var. *Liénardi* at Mauritius, also at Ceylon and Aden the above var. only; a large series of specimens in all stages of growth show that the two forms cannot be retained as distinct species.—The very common *Sistrum undatum* (Ch., fig. 1851-2, Tranquebar) must not be confused with the above, as well pointed out by Chemnitz in his original description, as also by v. Martens (Vorderasiat. Conch., p. 95); we have found the typical form of *S. undatum,* with whitish aperture, at Ceylon, Mauritius, and Natal; var. *Indica,* nobis, (de Blainv. pl. X, fig. 8) at Ceylon, Mauritius, Singapore, Bombay, Andamans, Penang, Arakan, Bourbon, and Seychelles; var. *subturrita* (de Blainv. pl. X, fig. 12) at Mauritius only, where it is rather scarce; the Museum also possesses specimens of var. *margariticola,* Brod. (Conch. Icon., fig. 28) from the N. Coast of Australia: this form differs from var. *Indica* by the fewer, more nodulous ribs, becoming more rapidly obsolete, by its stouter and thicker growth, by the more regular transverse sculpture, and by its more sombre colouration.

Conus Ceylonensis, Brug.

As already surmised by v. Martens (Don. Bism., p. 32), Pease is wrong (Am. J. Conch., 1867, p. 126) in uniting *Conus Ceylonensis*, Brug. with *Conus pusillus*, Ch. (Conch. Icon. fig. 154); both are abundant species at low water on the reefs at Ceylon and the Andamans; the latter species we have also found at Mauritius and the Seychelle Islands. Not only, how-

ever, the shells, but the animals also are quite distinct; the latter in *Conus Ceylonensis* being a bright scarlet throughout, the body minutely, almost imperceptibly streaked with white, the siphon the same, only much more distinctly so; the animal of *Conus pusillus* is, on the other hand, pure white, with a narrow pink rim round the extremity of the siphon and at its base, and the posterior end of the body is also tinged with pink.

Drillia lucida, n. sp., Pl. VIII, Fig. 15.

Shell acuminately fusiform, very smooth and glittering; white, slightly and irregularly marbled with pale brown here and there between the ribs and especially behind the outer lip; suture distinct, apex blunt and rounded, almost like that of *Pyramidella* in character; whorls 8 to 9, the two first smooth and embryonal, the others divided with a deeply incised groove beneath the suture, longitudinally, thickly, distantly ribbed; last whorl with 9 ribs, transversely striated at its base, gibbous posteriorly, with a rather considerable smooth space behind the marginal varix (as in Reeve's fig. 199, *Pleur. pudica*, Hinds), next the suture the upper part of the ribs, cut off by the deep spiral groove, have the appearance of a row of granules; columella and aperture smooth, a callous tubercle at junction of outer lip with the former, sinus very deeply excavated.

Long.8, diam. 3 mil.

H. and A. Adams in their 'Genera of Recent Mollusca' class *Clavatula quisqualis* of Hinds as a *Clathurella;* it would, however, probably be better placed in *Drillia*, as is done with other allied spp. *robusta*, Hinds, &c. *D. lucida* resembles extremely closely the shell from South America figured and described by Hinds as *Clavatula quisqualis* (Voy. Sulph., pl. VI, fig. 5); the Indian species is smaller, with transverse striæ at base of the last whorl, with a row of granules and a deep groove beneath the suture, and with straight instead of oblique ribs. The type is from the Persian Gulf, where it was dredged rather plentifully by Mr. Blanford off Tumb Island and Gwádar; it was also dredged by Mr. Wood-Mason at the Andamans and found by the late Mr. Raban at Pooree in the Bay of Bengal; the specimens from the two last-named localities differ slightly from the type form, being a little more richly marbled with brown (much as in Hinds' figure of his *Clavatula læta*), and having the ribs on the last whorl a trifle more rounded and the penultimate rib in the centre of the back more developed than the others (presenting a varicose appearance).

Drillia acuminata, Migh., Pl. VIII, Fig. 14.

P. Bost. Soc., 1845.

Shell fusiform, resembling in shape many small species of Mitra, somewhat smooth and shining, apex sharp and pointed (generally broken off);

bright brown, with a broad white band at the upper part of the whorls, repeated near base of the last whorl, this white band is more vivid and distinct on the ribs than in the interstices; whorls 8, the three first without sculpture, the others longitudinally flexuously ribbed, with a depression beneath the suture, last whorl transversely ribbed at its base, with approximately 12 longitudinal ribs, two of which in the centre of the back are joined together and have a varicose or gibbous appearance; columella and interior of aperture brown, smooth, outer lip sharp, very thin, sinus small.

Long. max. 6¼, diam. max. 2½ mil.

Andaman I. and Ceylon, scarce at both places. We have given a fresh figure of this species from an Andaman specimen, as the figure in the Don. Bism. (pl. 1, fig. 1) is scarcely sufficient for satisfactory identification. Typical specimens in the Indian Museum from the Sandwich Islands in no respect differ from Indian Ocean ones.

MANGELIA FULVOCINCTA, n. sp., Pl. VII, Fig. 1.

Shell attenuately fusiform, shining; whorls nine, the first four embryonal and colourless, the third and fourth peculiarly and strongly carinate, the other five longitudinally, varicosely ribbed, seven ribs on the last whorl; under a lens, minutely but regularly transversely striated, striæ more or less obsolete on the ribs; white, with a chestnut-brown band immediately under the suture, more vivid in the interstices than on the ribs themselves, this brown band covers the columella and nearly the whole of the lower half of the last whorl, is also very strongly marked on the lower portion of the outer lip and within the aperture; columella and outer lip smooth, sinus obsolete, canal very short and truncate.

Long. 8, diam. 3 mil.

Type Bombay (Rev. S. B. Fairbank), also Ceylon (nobis), and Pooree (H. H. Raban).

(Coll. Indian Museum and H. Nevill.)

MANGELIA FAIRBANKI, n. sp., Pl. VII, Fig. 2.

We have long hesitated whether this shell should be distinguished from Reeve's *Pl. hexagonalis*, the differences between our shell and the figure in the Conch. Icon. seem however to necessitate it. *M. Fairbanki* can be distinguished by the more open canal, the five or six denticulations within the acute outer lip, the sharp transverse striæ, equally and strongly showing both on the ribs and in the interstices, the striæ distant from one another, only three on each whorl, the middle one slightly the largest, imparting a somewhat angulate appearance to the whorls; the longitudinal ribs are thicker and more rounded than in Reeve's figure; the shell has 8 whorls, the two first embryonal, slightly mammillate;

it is of an irregular leaden-brown colour, stained with a darker shade on the outer lip and on the columella.

Long. 6, diam. 2 mil.

Type Bombay, probably also Ceylon and Andamans; the specimens, however, from these two last localities are not sufficiently perfect for satisfactory identification. For the type specimens of this and for many other interesting species from the same locality, the late Dr. Stoliczka was indebted to the Rev. S. B. Fairbank.

MANGELIA (?) INTERRUPTA, Rv.

P. Z. S. 1846.

Daphnella bella, Pse.

Pl. gemmulata, D.

Amongst some hundred specimens in the Museum from the Sandwich I., Mauritius, Bourbon, Ceylon, and Abyssinia, a single Ceylon specimen alone shows minute denticulations just within the outer lip, as in Reeve's figure. A comparison with specimens in the British Museum marked *interrupta*, Rv. first enabled us to identify this species; the genus still seems to us doubtful, perhaps Carpenter (P. Z. S. 1865) is correct in placing it in the *Columbellidæ*. It is common in Ceylon, where it seems to be finer and better marked than elsewhere in these seas. If it should prove to be a pleurotomid, Pease's name *bella* had probably better be employed, as Lamarck and Sowerby have both described distinct shells as *Pleurotoma interrupta.*

CLATHURELLA RUGOSA, Migh.

Pl. curculio, Nevill, J. R. A. S. (Ceylon Branch), 1869.

Pease is quite wrong (Am. J. Conch. 1871, p. 25) in uniting this species with *C. scalarina*, Deshayes; the short rounded whorls, more produced spire, different character of the sculpture, absence of the second black transverse line on the whorls, amply distinguishing the latter; the former is abundant at Ceylon and Arakan, the latter at Mauritius, Bourbon, and Ceylon.

C. RUGOSA, var. CURCULIO, nobis, l. c., from Ceylon.

This variety has 12 longitudinal ribs on the last whorl, four transverse keels on the whorls, the two middle ones very prominent, the other two more or less obsolete, suture excavated, only very faintly stained brown, minutely and spirally striated; two transverse brown lines on the last whorl, showing also within the aperture; it does not differ from the type form sent us by Mr. Pease from the Sandwich I., as figured and described in the Don. Bism., except by its greater size.

Long. 8, diam. $3\frac{3}{4}$ mil. (last whorl, long. $4\frac{3}{4}$).

C. RUGOSA, var. FALLAX, nobis.

This is probably the form that induced Pease incorrectly to make *scalarina* a synonym of *rugosa.* This dwarf variety has 9 longitudinal ribs on the last whorl, the four transverse keels are less unequal in size, there is only one brown line on the last whorl and within the aperture (in this respect only does it agree with *scalarina) ;* the peculiar straight outer lip and consequently contracted aperture, as also the form of the whorls and suture, are the same as in the type form.

Long. $4\frac{1}{2}$, diam. 2 mil. (last whorl, long. 2).

Common at Mauritius and Bourbon ; rare at Ceylon.

CLATHURELLA SCALARINA, Desh.

Specimens in the Museum agree exactly with the typical figure (especially as regards the rounded outer lip and open aperture) ; suture scarcely excavated, spirally minutely striated, six transverse keels on each whorl (the first and last somewhat indistinct), 12 longitudinal ribs on the last whorl (not 15 to 16 as in the original description) ; apex and suture stained an intense brown, only one brown line on the last whorl and within the aperture.

Long. 6, diam. $2\frac{1}{4}$ mil. (last whorl, long. $2\frac{1}{2}$).

Abundant at Balapiti in Ceylon ; rare at Mauritius.

CLATHURELLA EXQUISITA, n. sp.

We found this shell marked in the British Museum as *Clathurella nebulosa,* Pease, but it differs totally from the shell described under that name (P. Z. S., 1860, p. 143), being of a beautiful pink colour with a white transverse band, not white with interrupted longitudinal brown lines as in Pease's description of *P. nebulosa ;* it may rather prove to be a small variety of the shell described and figured by Pease from Paumotus (Am. J. Conch., 1868, p. 219) as *Clathurella canaliculata ;* however, even if it should prove so, our name *exquisita* will stand for the species, as Reeve described a totally different shell as *P.* (*Clathurella*) *canaliculata,* P. Z. S., 1848 ; if the Paumotus shell proves to be distinct from our Mauritius one, as we think it is, we would suggest for the former the name of *Clathurella Peasei. C. exquisita* differs from *C. Peasei* by the absence of the dark brown line beneath the transverse white band, by its suture not being coloured brown, by the much greater contraction of the last whorl and the outer lip at their base, thus making a more prominent canal, by the last whorl having only 12 longitudinal ribs instead of 14, finally by its smaller size. We have not thought it necessary to figure this species, as it is one that cannot be mistaken.

Long. $9\frac{3}{4}$, diam. 4 mil.

Rather scarce at Mauritius.

CLATHURELLA REEVEANA, Desh.

Seems to be the same as a shell figured and described by Pease as *C. tumida* (Am. J. Conch. 1867). This species occurs at Mauritius and at the Andamans, at both of which places it is scarce. *C. Reeveana* and *C. cyclophora*, D. should, we think, form a distinct section of Clathurella, in which should probably be classed *P. subula*, *ægrota*, &c. of Reeve ; in Adams' 'Genera' these latter are recorded as Daphnella.

C. cyclophora we found at Mauritius rather sparingly, also at Aden a single specimen of a shell which seems to belong to it, though in too bad a state of preservation for certain identification.

CLATHURELLA SMITHI, n. sp., Pl. VIII, Fig. 13.

Shell minute, angularly fusiform, attenuated, apex round, slightly sinistral ; white, tinged with pale brown on the columella and outer lip ; whorls seven, acutely angled in the centre, depressedly excavated on the upper half, which is devoid of sculpture ; the first two whorls altogether without sculpture, the 3rd and 4th simply acutely keeled in the centre, the others closely reticulated, minute granules formed where the keels bisect one another, longitudinal keels obsolete on the lower half of the last whorl ; in some specimens a prominent keel is present immediately beneath the suture of the last two whorls, in most, however, this is obsolete (as in the specimen figured) ; columella rather strongly twisted, sinus deep, outer lip reflected, transversely striated.

Long. $3\frac{1}{2}$, diam. $1\frac{1}{3}$ mil.

Mr. Blanford dredged 30—40 specimens of this minute shell off Gwádar and Tumb Island in the Persian Gulf ; it perhaps nearest resembles Reeve's *Pl. concentricostata* (fig. 279), but is quite distinct ; we have named it after Mr. E. A. Smith of the British Museum, who has lately described some interesting small shells from the Persian Gulf.

CLATHURELLA APICULATA, Montr., Pl. VII, Fig. 3.

J. de Conch. 1864, p. 264, (*N. Caled.*)

We propose to distinguish the Andaman form under the name of var. *minor*. Ten specimens of this variety were found living at Ross Island under blocks of coral at low water, it can only be distinguished from the type form, which has not yet been found at the Andamans, by its smaller size (long. $4\frac{1}{2}$, diam. $1\frac{3}{4}$ mil.). The row of opaque, white spots on the back of the last whorl are very characteristic. It is nearest allied to the next species, *C. Malleti*, which also lives at the Andamans and under precisely similar conditions : the slight but constant differences in shape and sculpture between the two are well shown in the accompanying figures. Dead specimens of *C. apiculata* are fairly abundant in Ceylon, in size closely approximating to the type form (long. $6\frac{1}{4}$, diam. 3 mil.)

(Coll. Indian Mus., Rev. J. Warneford, and H. Nevill.)

Clathurella Malleti, Recl., Pl. VII, Fig. 4.

J. de Conch. 1852, p. 254, (*Pacific O.*)

I found seven or eight specimens of this lovely species alive at the Andamans, at Ross Island and North Bay, under blocks of coral at low water; the shell is of the most brilliant purple imaginable; it agrees exactly with the original figure and description. (G. Nevill.)

(Coll. Indian Mus. and Rev. J. Warneford.)

Clathurella perplexa, n. sp., Pl. VII, Fig. 5.

This shell, though in many respects so like *Mangelia Fairbanki*, should probably be classed as a *Clathurella;* whorls 8, the last very short, three first embryonal, the others broadly, somewhat indistinctly longitudinally ribbed, ribs not so straight as in *M. Fairbanki*, but somewhat rounded, especially on the last whorl, three raised transverse striæ on the lower portion of each whorl, the uppermost one almost obsolete, a characteristic raised transverse keel immediately below the suture; uniform ash-color, a shade or two darker in the interstices of the ribs and near the apex; columella, outer margin of the lip and interior of the aperture bright chestnut-brown, columella a little twisted, outer lip very sharp, irregularly undulating, obsoletely granulated just within the aperture.

Long. 6, diam. $2\frac{1}{2}$ mil.

Type Bombay; also found in Ceylon.

(Coll. Indian Museum, and H. Nevill.)

Clathurella nigrocincta, Montr., Pl. VII, Fig. 6.

J. de Conch. 1872, (*N. Caled.*)

The colouration of the last whorl is remarkable: there are five rows of distant elongated nodules, of which the two first rows next tho suture are of a leaden colour on a broad black band, the third row of a brilliant orange, the fourth and fifth pure white, these five rows of nodules (coloured in the same way) are then repeated.

About twenty living specimens of this shell were found at the Andamans, on Blair's Reef, Aberdeen, and Ross Island, under blocks of coral at low water.

Long. 9, diam. 4 mil.

Clathurella singularis, n. sp., Pl. VII, Fig. 10.

Shell elongate, fusiform, sub-conical, apex pointed; white, in the centre of the ribs on the last whorl ornamented with obsolete brown spots; whorls nine, the first four embryonal, smooth, on the fourth traces of convex sculpture only, the last five transversely, regularly, rather broadly, somewhat distantly striated, longitudinally faintly and obtusely ribbed, nine ribs on the last whorl, becoming obsolete towards the base, the last rib next the

outer lip varicose, much more strongly developed than the others; ribs of the 5th and 6th whorls perfectly straight, on the 7th and 8th angulated about the middle, the last whorl angulated at about the 4th or 5th of the transverse striæ; columella straight, smooth, a small tooth-like projection at the commencement of the deep, rounded sinus; outer margin of the lip almost straight, much produced, exceedingly sharp; interior of aperture white, smooth, and shining; under a powerful lens only can be seen a microscopical, regular, longitudinal striation, these striæ are bent in the same way as the last varicose rib and should perhaps be called striæ of growth, they are a trifle more distinct close to the suture.

Long. $8\frac{1}{2}$, diam. $3\frac{1}{2}$ mil.

(Coll. Indian Mus. and Rev. J. Warneford.)

Three or four specimens only of this interesting species were dredged by Mr. Wood-Mason at a considerable depth at the Andamans. In shape and sculpture it resembles most closely *Cythara Delacouriana* of Crosse (J. de Conch. 1872, pl. fig.); the columella and outer margin are, however, both perfectly smooth and the sinus is much more distinct, the spire too is a great deal longer in proportion to the last whorl, in length the last whorl (measured at the back) is $4\frac{1}{2}$ mil., the other whorls altogether only measuring 4 mil. We have felt considerable doubt whether this species is correctly classed as a Clathurella; perhaps it would be better placed with Mangelia.

CLATHURELLLA MASONI, n. sp., Pl. VII, Fig. 7.

Shell ovately fusiform, white, remarkably scalariform; six angular whorls, broader at the top than at their base, the first two rounded, smooth and embryonal, the others prominently and regularly, somewhat distantly, transversely striated (four striæ on the 4th and 5th whorls), longitudinally strongly ribbed, ribs pointed and very prominent at their commencement, nine of them on the last whorl; columella and aperture smooth, with a row of regular, rounded granules just within the acute margin of the outer lip, this latter is very broadly reflected and has a longitudinal, somewhat obsolete rib down its centre, this being decussated by seven transverse striæ presents the appearance of a double row of granules; the outer margin where it joins the body whorl is callous and thickened, the sinus very deep and rounded, the aperture small, contracted, as nearly as possible of equal width all the way down from the sinus to the end of the canal. This species agrees remarkably, as regards sculpture and shape of the whorls, with a shell described as *Pl. scalata* by Souverbie (J. de Conch., 1874, pl. VIII, fig. 4); it differs, however, by the totally different character of the aperture and by its fewer whorls.

Long. 4, diam. 2 mil.

Dredged by Mr. Wood-Mason at the Andamans.

CLATHURELLA MARTENSI, n. sp., Pl. VII, Fig. 8.

Shell regularly and conically fusiform, of rather dark brown colour with bright lilac granules; seven rounded whorls, reticulated with very thick somewhat distant ridges, forming at the points of intersection, three rows of large, pearl-like, slightly oblong granules, on the last whorl these three rows of granules are repeated, after the sixth row the shell abruptly becomes contracted, forming an excavated furrow, near the base there are again six rows of granules, but much smaller and more rounded, these give a somewhat angular appearance to the last whorl; the columella is much contorted, or twisted in the middle, of a lilac colour, with a few minute denticulations at its edge; the aperture and the four strong denticulations at its outer edge are also of a lilac colour, the sinus is deep and rounded, the outer lip is bright brown, abruptly contracted near its base, forming a strongly marked canal.

Long. 5, diam. 2 mil.

Tolerably abundant in sand from Balapiti in Ceylon.

(Coll. Indian Mus. and H. Nevill.)

CLATHURELLA ENGINÆFORMIS, n. sp., Pl. VII, Fig. 9.

Shell narrowly elongate, convex, in shape resembling several species of the genus *Engina*, peculiarly attenuated and contracted towards the base, spire pointed; white, banded with a single somewhat irregular yellow band, repeated a little below the middle of the last whorl, some of the granules on this band are yellow, whilst others are white; whorls seven, distantly reticulated with thick, obtuse, longitudinal and transverse keels, the interstices, under a lens, minutely and closely longitudinally striated, the sculpture is very distinct and clearly marked on the last two whorls, but much confused and difficult to trace on the upper ones; as in the preceding species, pearl-like granules are formed where the ridges cross one another, in the present shell however they are more regular in size and more rounded, there are three rows of these granules on each whorl, besides an additional smaller one and some indistinct transverse ridges close to the suture; there are ten longitudinal keels on the last whorl; sinus deep, but rather contracted, bent down rather abruptly; aperture very straight and narrow, suddenly widening a little close to the end of the canal, seven rather large regular granules at the inner margin of the outer lip.

Long. $5\frac{1}{2}$, diam. $2\frac{1}{4}$ mil.

In sand from Balapiti in Ceylon.

(Coll. Indian Museum and H. Nevill.)

CLATHURELLA LEMNISCATA, Nevill, Pl. VII, Fig. 11.

J. R. A. S. (Ceylon Branch), 1869.

White, with one brown band just below the sutures and with a second one towards the base of the last whorl, the latter fills the excavated furrow and shows also in the interior of the aperture, the columella also is stained brown; whorls seven, distantly latticed with very broad longitudinal and transverse keels, forming oblong granules where they cross one another, there are four of these transverse granulose keels on each whorl, the upper one small and somewhat indistinct, the two middle ones very prominent, the lowest one small, scarcely perceptible, almost hidden by the next whorl; the last whorl has five of these keels, the first smaller than the others, then an excavated furrow as in *Clathurella fusoides*, Reeve, and in *Clathurella Blanfordi*, nobis.

Long. $6\frac{1}{2}$, diam. $2\frac{1}{2}$ mil.

In sand from Ceylon and Maüritius (nobis), Bombay (Rev. S. B. Fairbank), and Gwádar in Persia (W. T. Blanford).

We give a figure, from a Mauritius specimen, of this widely distributed little species.

(Coll. Indian Museum and H. Nevill.)

CLATHURELLA CONTORTULA, n. sp., Pl. VII, Fig. 12.

Shell globosely conical, somewhat peculiarly twisted or bent, suture distinct; white, with a pink tinge towards tbe top; apex very obtuse, with a decollated appearance; whorls 6, longitudinally ribbed, ribs thick and prominent, distantly transversely striated, so as to present a granulose appearance; at the base of the last whorl several rows of small granules; columella peculiarly twisted, aperture narrowly contracted, outer lip thick, in the middle bent inwards. This shell seems very close to Reeve's *Pl. obtusa*, the shape however is different, the aperture more contracted, &c.

Long. $5\frac{1}{2}$, diam. $2\frac{1}{2}$ mil.

Abundant in sand from Balapiti in Ceylon.

(Coll. Indian Museum and H. Nevill.)

CLATHURELLA BLANFORDI, n. sp., Pl. VII, Fig. 14.

Shell cylindrically ovate, elongate, sutures rather indistinct, apex sharp and pointed, a beautiful deep mauve colour throughout; whorls 7 to 8, longitudinally and transversely ribbed, ribs very prominent, of equal thickness, forming granules at the points of intersection, towards the base of the last whorl an excavated furrow as in our *C. lemniscata*, &c.; columella short and twisted, aperture moderately wide, contorted, with a rather large sinus, outer lip thickened with two or three granules just within the aperture.

Long. $5\frac{3}{4}$, diam. $2\frac{1}{8}$ mil.

In sand from Annesley Bay in Abyssinia. I have named this prettily coloured little shell after Mr. W. T. Blanford, to whom the Indian Museum is indebted for it, as well as for very many other interesting species from the same locality.

CLATHURELLA ARMSTRONGI, n. sp., Pl. VII, Fig. 13.

Shell pyramidically elongate, angular in the middle of the whorls, very pointed at base, suture distinct, apex very sharp and pointed; colour uniform chocolate-brown; whorls eight, the first two perfectly smooth, the 3rd and 4th with two transverse keels in the centre, the last four obtusely and distantly longitudinally ribbed, transversely regularly striated; columella much contorted or twisted, with a shining callosity which is prominently rugosely granulated as in the genus Cythara; aperture short and much contorted, with a large, prominent, tooth-like tubercle at the junction of the outer lip with the columella and with a remarkably wide, deeply excavated sinus; outer lip thickened, transversely striated, peculiarly and minutely, very closely granulated just within the aperture; in three of the four specimens the columella and margin of the outer lip are stained a brighter brown than the rest of the shell. The above characters will serve easily to distinguish this shell from *Pl. arctata* of Reeve, the only species which, as far as we know, it at all resembles.

Long. 5, diam. $2\frac{1}{4}$ mil.

The type was dredged by Mr. Wood-Mason at the Andamans in 25 fths. Dr. Armstrong of the Indian Coast Survey has also presented to the Indian Museum three specimens, which he dredged at about the same depth in the Paumben Straits, in these latter the columella and outer lip are stained a bright brown, but there is no other difference from the type form.

CYTHARA GRADATA, n. sp., Pl. VII, Fig. 15.

Shell compressedly, ovately oblong; sutures excavated, apex very obtuse, having a decollated appearance, pure white throughout; whorls six, longitudinally ribbed, ribs continued to the extreme base of the last whorl, transversely very regularly striated, columella almost straight, slightly rugose at its upper part; aperture narrowly contracted, especially towards its base, sinus small; outer lip very thick, regularly rounded, granulated just within the aperture.

Long. $5\frac{3}{4}$, diam. 2 mil.

Not uncommon in sand from Balapiti in Ceylon (nobis) and Bombay (Rev. S. B. Fairbank).

(Coll. Indian Museum and H. Nevill.)

CYTHARA DUBIOSA, n. sp., Pl. VII, Fig. 18.

We have felt considerable doubt whether the present species is really distinct from the shell described by Reeve as *Mangelia coniformis*, Gray

MS., the greater thickness of shell, straighter outer lip, and less oblique longitudinal ribs seem, however, to distinguish the present form. Shell ovately conical, thick, apex mammillate; white, with a broad brown stain on the back of the last whorls; whorls 7, the first three embryonal, the next three angular, the longitudinal ribs only beginning towards the base of each of them, give the appearance of a row of nodules just above the suture; the last whorl unusually straight and regular, with an excavated shelf at the top, transversely and closely striated, striæ somewhat obscure, peculiarly undulating and interrupted, decussated with somewhat indistinct longitudinal almost straight ribs, commencing at the base of the excavated shelf; regularly and closely denticulated both on the rather widely spreading callosity covering the columella and also just within the margin of the straight outer lip; aperture contracted, much straighter and narrower than in Reeve's figure of *coniformis*.

Long. $7\frac{1}{2}$, diam. 4 mil.

Apparently very scarce, four specimens in sand from Mauritius and one from Port Blair, Andamans.

Cythara Isseli, n. sp., Pl. VII, Fig. 17.

Shell thick, ovately conical, suture very distinct, apex pointed; white, with an orange band in the middle of the whorls, the band repeated on the last whorl, this band is distinct on the longitudinal ribs, but only here and there traceable in their interstices; whorls seven, the first three embryonal (in dead specimens nearly always wanting), the others longitudinally concentrically ribbed, ribs very thick, throughout closely transversely striated; columella nearly straight with a moderate sized callosity, closely covered with distinct granules and transverse rugosities; aperture narrow, widening somewhat abruptly near the base, sinus moderate, outer lip thickly reflected, transversely striated, slightly rounded, a row of large, regular granules just within the aperture.

Long. $7\frac{3}{4}$, diam. 4 mil. (decollated specimen of four whorls only).

Common in sand from Balapiti, Ceylon.

I have named this shell after M. Issel of Genoa, whose works on the shells of the Red Sea, Persia, and Borneo, afford most valuable aid in determining our Indian Ocean shells.

(Coll. Indian Museum, Rev. J. Warneford, M. Issel and H. Nevill.)

Cythara Isseli, var. Cernica, (? sp. nov.), Pl. VII, Fig. 16.

Considerably smaller than the type form, the entire, full grown figured specimen being only $6\frac{1}{2}$ in length and $2\frac{3}{4}$ mil. in breadth; there is apparently no other difference, except that the sinus is a trifle less distinct, and the aperture a little straighter.

Mauritius,—rare.

Marginella (Glabella) picturata, Nevill, Pl. VIII, Figs. 8—9.

J. A. S. B. 1874, p. 23.

We have nothing to add to our description of this pretty little shell, which would appear to be very local, as we have only seen specimens from the Mauritius.

Marginella (Volvarina) inconspicua, Nevill, Pl. VIII, Figs. 10—11.

J. A. S. B., 1874, p. 23.

The Museum is indebted to the Rev. S. B. Fairbank for specimens of this species from Bombay; the type is from Mauritius, where it is tolerably abundant.

Marginella (Volvarina) deformis, Nevill, Pl. VIII, Fig. 12.

J. A. S. B., 1874, p. 23.

This appears to be a very rare shell, three or four specimens, all from Ceylon, being the only ones we have ever seen.

Marginella Isseli, n. sp.

We propose to change to *Marginella Isseli* the name of a shell called *M. pygmæa* by Issel (Malac. del Mar Rosso, p. 216), there being already a species of that name described by Sowerby in 1846. This minute species was dredged abundantly by Mr. W. T. Blanford off the coast of Persia in 25 fths.

Nassa obesa, n. sp., Pl. VIII, Figs. 2—3.

Shell thick, stout, globosely conical, smooth and shining, spire very pointed, apex acute; brown, indistinctly and minutely mottled with white, irregularly stained near the suture with a darker shade of brown, the colouration agrees perfectly with Reeve's fig. 6 (*mutabilis*, L., from the Mediterranean); whorls 10, the three first without sculpture, very small, the others longitudinally, obliquely thickly ribbed; the ribs and their interstices are of about equal thickness, the former are almost, or altogether, obsolete on the back of the last whorl, four or five, however, are always present close to the callous rib behind the outer lip; transversely somewhat distantly grooved, the grooves towards the base of the last whorl and the two or three upper ones more deeply incised than the others and forming two rows of more or less granulose ridges immediately beneath the suture; columella with a moderately large white callosity, slightly rugose, aperture ridged near its margin.

Long. max. (wanting the three first embryonal whorls) 22, diam. max. 14 mil.

Kutch,—rare. Major Godwin-Austen has been good enough to compare this species for us with the British Museum and Mr. Hanley's collections: he

confirms our opinion that it appears to be new, the nearest he could find being Reeve's *algida* (Conch. Icon., fig. 145), from Moreton Bay, Australia; the present species bears a remarkable resemblance in many respects to *N. mutabilis,* its thickness, different sculpture, rugose columella, &c. will, however, distinguish it. At Ceylon and Penang we have found a variety which approaches nearer to *N. algida* than the figured type form from Kutch.

N. OBESA, nobis, var. CEYLONICA.

More acuminate, less globose, suture more distinct; longitudinal ribs on the antepenultimate whorl more or less obsolete, transverse grooves on the last two whorls almost obsolete; callosity on the columella a shade more defined and less rugose.

Long. (perfect specimen) 19, diam. 10 mil.

Ceylon and Penang.

(Coll. Indian Museum and H. Nevill.)

NASSA PERSICA, v. Mart.

Deshayesiana, Iss.

A common shell both at Aden and the Andaman Islands. It is admirably described and figured in a most interesting and important paper by von Martens, published as a separate part of the 'Nov. Conchol.' under the title of 'Ueber vorderasiatische Conchylien.'

COLUMBELLA PARDALINA, Lam.

This most variable species abounds on the reefs at the Andamans, where one of us collected many hundreds of specimens in all stages of growth. Pure white specimens, exactly agreeing with Souverbie's figure, were abundant, another very similar variety also occurs, white with a broad pale yellow band round the last whorl (with or without a few yellow spots on the spire); specimens marked like Reeve's fig. 75 A. and C. are also common, but considerably smaller and more compressed: this last variety may be called *Andamanica.*

Typical form, very common in Ceylon, long. 16½, diam. 9 mil.

Var. *lactescens,* Souv., J. de Conch. 1866, long. 13, diam. 7 mil.

Var. *Andamanica,* long. max. 12¾, min. 10, diam. max. 6½ min. 4¼ mil.

COLUMBELLA (MITRELLA) BALTEATA, n. sp., Pl. VIII, Fig. 4.

Shell small, elongately fusiform, spire about the same length as the last whorl, apex pointed, of a bright red colour; light reddish brown, a single belt of dark red in the middle of the whorls between the ribs, the ribs themselves in their centre are indistinctly white spotted; whorls 7, the upper ones smooth, the others longitudinally ribbed, ribs obsolete near the suture;

transversely indistinctly striated, a groove below the suture of the upper whorls, becoming obsolete near the last whorl; columella simple and twisted, outer lip acute, slightly emarginate at the top, aperture striated within.

Long. 5, diam. $1\frac{4}{5}$ mil.

Mauritius. Not common.

ZAFRA POLITA, n. sp., Pl. VIII, Fig. 5.

Shell small, slenderly fusiform, attenuated at both ends, perfectly smooth, glistening spire contorted, nearly but not quite as long as the last whorl; white, with two bands of irregular opaque white flakes on each whorl (four on the last); whorls 6 (the figured specimen has had the first broken off), the last striated at its base, outer lip remarkably thick and bent inwards, making the aperture peculiarly contracted.

Long. $3\frac{1}{2}$, diam. $1\frac{1}{3}$ mil.

Mauritius,—rather scarce.

Easily distinguished by the absence of sculpture and by its remarkably contracted aperture from its nearest ally, *Z. ornata*, Pease. *Z. purpurea*, H. Ad. from New Hebrides is also found at Mauritius.

ZAFRA SEMISCULPTA, n. sp., Pl. VIII, Figs. 6—7.

Shell narrowly lanceolate, turreted, spire a little longer than the last whorl, apex pointed; horny-brown throughout; whorls 7, the three first without sculpture, the rest longitudinally thickly ribbed, ribs about twice as broad as their interstices (in this respect our figures are slightly at fault), obsolete on the back of the last whorl, which is transversely striated at its base; a sharply defined callosity covers the columella, outer lip scarcely thickened or reflected, not as long as the columella, slightly emarginate at junction with the last whorl; aperture narrow and contracted, as wide at the top as at the base.

Long. 3, diam. 1 mil.

This species was dredged by Mr. Blanford at Cape Negrais, off the coast of Burma.

SISTRUM VENTRICOSULUM, n. sp., Pl. VIII, Fig. 16.

Shell small, ovately ventricose, very gibbous in the middle, thick, solid, abruptly attenuated at base; spire short, acutely pointed, about half the length of the last whorl; white, here and there stained with pale brown; whorls 7, the first four very small, embryonal, without sculpture, the next has two rows of unequal granules, the lower row somewhat pointed and much the larger; the last whorl widely excavated at the suture, with a row of prominent granules, rounded beneath with distant, somewhat indistinct longitudinal ribs, transversely rather distantly keeled, forming slightly pointed granules where they intersect the ribs, the interstices under a lens very mi-

nutely and closely longitudinally striated; columella with a moderately spread callosity, which is slightly rugose; canal long, not recurved; four denticulations within the aperture, the two upper ones very thick and prominent, outer lip much thickened, slightly emarginate at the upper part.

Long. $5\frac{3}{4}$, diam. $3\frac{1}{2}$ mil.

Ceylon — Rare.

This is the smallest species of the genus as yet described.

Eulima acuformis, n. sp., Pl. VIII, Fig. 1.

Shell very elongate, sharply pointed, white and shining, solid, flexuous; whorls 17, cylindrical, slightly angulate at their base, except the last whorl which is short and rounded; no impressed line at the suture, varices obliquely continuous; aperture oblong, slightly produced in front, rounded at base; columella reflected, outer lip scarcely thickened.

Long. 10, diam. $2\frac{3}{4}$ mil.

Dredged at the Andaman Islands by Mr. Wood-Mason.

Rare. The above character will easily distinguish this graceful shell from its nearest allies, *E. lactea* and *flexuosa*, A. Ad.

(Coll. Indian Museum and Rev. J. Warneford.)

Eulima (Arcuella) mirifica, Nevill.

J. A. S. B. 1874, (*Mauritius*).

We have lately noticed that H. and A. Adams described a genus under the name of *Bacula*, allied to *Eulima*, (in A. & M. N. H., 1863, Vol. XI, p. 18) founded on a species from China, which they called *striolata;* this shell probably belongs to the same genus as the species from Mauritius, which we described as above; in either case our name for the genus, or sub-genus, will stand, there being a genus *Baculum* described prior to 1863.

Mitra (Turricula) cruentata, Ch.

Fig. 1438-9, *from the E. Indies.*

Typical specimens, as admirably figured by Chemnitz, are found at the Nicobars (probably the locality whence the type came) and Andamans; they have two white bands on the last whorl, with 10 to 11 distant, flexuous ribs, nodosely angled at the upper part; the transverse grooves rugose, approximately equally incised, forming tolerably regular and oblong granules where they intersect the ribs.

Long. $19\frac{1}{2}$, diam. 8 mil.

M. cruentata, Ch. var. proxima.

This is the shell from the Philippines figured by Reeve (fig. 126) for *cruentata*, Ch.; it is a form which is often mistaken for Reeve's *M. armillata;* it has 16 ribs on the last whorl, is a trifle less flexuous, and less prominently

angled at the upper part than the type form; the transverse grooves and double white band are similar.

Common at the Andaman I.

Long. 19, diam. $6\frac{3}{4}$ mil.

M. cruentata, Ch. var. Sandvichensis.

Extremely close to the preceding is the form from Ascension I. (Pacific O.) sent to us by Mr. Pease as "*M. armillata* (?) perhaps *cruentata*, Ch." This variety is recorded in the 'Donum Bismarckianum' as *armillata*, Rv.; from which it differs by the less flexuous ribs and different shape of the whorls, being nearer Reeve's *amanda;* it seems to us to be best classed as a variety of *cruentata*, Ch.: the whorls are not angulate near the suture, the transverse grooves are nowhere rugose but are more or less obsolete in the centre of the last whorl; a groove at the upper part being more deeply incised than the others (in this respect it agrees with *armillata*), gives the appearance of a row of prominent, bisected tubercles just below the suture; there are 21 ribs on the last whorl, which are only very slightly flexuous, it has a single white band only.

Long. $5\frac{2}{3}$, diam. 6 mil.

M. cruentata, Ch., var. amanda, Rv.

Reeve's *M. amanda*, (fig. 318) from the Philippines is only a variety of this protean species. Specimens dredged abundantly by Dr. Stoliczka at Singapore agree exactly with Reeve's typical figure and description. It differs from *cruentata* var. *proxima* by the whorls not being angulate, by a deeply incised groove near the suture, forming a row of oblong tubercles next the suture, by the much greater width of the white bands and by the less vivid orange tinge of the ribs, which are 16 to 20 in number; and from *cruentata* var. *Sandvichensis* by the more regular and rugose transverse striation and by the broad double white bands;—it is in fact intermediate between the two.

Long. 13, diam. 5 mil.

Two specimens from Aden, unfortunately not in good condition, apparently belong to this variety, the ribs are, however, more distant. Reeve's *armillata* (fig. 315) from the Philippines, may perhaps prove also to be a variety of *cruentata*, or it may be a variety of *obeliscus*, Rv.; it seems intermediate between the two.

Mitra (Turricula) obeliscus, Rv. var. Andamanica.

Pl. VIII, Figs. 19—20.

Shell slenderly fusiform, shining; very dark brown with a single very narrow white band, more distinct on the ribs than in their interstices; whorls 9—10 (as in *M. cruentata* and all its varieties), produced, very slightly

turreted, not angulate at the upper part; 18 flexuous longitudinal ribs on the last whorl, perfectly smooth except near the suture, where they are divided by a groove, interstices transversely regularly grooved; canal short, not recurved, columella and interior of the aperture dark brown.

Long. 14, diam. $4\frac{3}{4}$ mil.

Dredged by Mr. Wood-Mason at the Andamans.

This shell in many respects resembles Reeve's *M. armillata;* the above characters will, however, easily distinguish it.

MITRA (TURRICULA) RADIUS ?, Rv. (an DÆDALA, var. ?) Pl. VIII. Figs. 17—18.

Shell pyramidically fusiform, pointed, shining; white, with a broad brown band over the lower half of the last whorl and within the aperture, apex brown; whorls 10, turreted, more cylindrical and produced than those of *M. dædala*, Rv. (fig. 281) or *glandiformis*, Rv. (fig. 310); longitudinally flexuously ribbed, ribs slightly thickened near the suture, interstices regularly engraved with transverse striæ; four folds on the columella, the lower one almost obsolete (Reeve gives only two folds to his *M. radius*).

Long. $13\frac{1}{2}$, diam. $4\frac{1}{2}$ mil.

Dredged by Mr. Wood-Mason at the Andamans; rare.

This seems to be doubtfully distinct from *M. dædala* and *glandiformis*, both of which are common shells at the Andamans and at Ceylon; they all appear to run into one another and may prove to be varieties of one and the same species.

MITRA (SCABRICOLA) PRETIOSA, Rv.

P. Z. S. 1846.

Mitra Antoniæ, H. Ad., P. Z. S. 1870, (*Red Sea*).

This species also was lately obtained rather abundantly by Mr. W. T. Blanford in the Gulf of Oman on the coast of Persia, as also was *Turricula* (*Thala*) *casta*, H. Ad. (P. Z. S. 1872, p. 9, from the Red Sea) and a new species very closely allied to the latter.

RISSOINA (?) ABNORMIS, n. sp., Pl. VIII, Fig. 23.

Shell small, thick, shortly fusiform, white, suture distinct; apex remarkably abruptly and truncately sinistral, as in the *Pyramidellidæ;* whorls 6, the two first embryonal, without sculpture, the others longitudinally somewhat thickly ribbed (the figured specimen being rather young, the ribs are less developed than in mature specimens), the last whorl rounded, with about 15 ribs, obsolete towards the base; throughout transversely, closely, somewhat rugosely striated, so as to form minute, indistinct granules where the striæ intersect the ribs; columella strongly twisted at base, covered with a moderately widely spread callosity; aperture small, peculiarly

deeply channelled at base, within showing the transverse striation on the back of the last whorl; outer lip produced, rounded, no sign of any emargination at the upper part, much thickened, transversely striated, with a subgranulose appearance, crenulated at the margin.

Long. max. 3, diam. max. $1\frac{1}{3}$ mil.

Mauritius; not uncommon in sand.

This should probably constitute a distinct sub-genus of *Rissoina*, distinguished by the very distinct canal, twisted columella and sinistral apex; a shell dredged in Japan by A. Adams and distributed by him as "*Lachesis*, n. sp." is a very closely allied species.

Cyclostrema eburnea, n. sp., Pl. VIII, Figs. 21—22.

Shell depressedly orbicular, thick and callous, ivory white and shining, suture distinct; whorls 5, sharply angled a little below the centre; longitudinally obliquely plicated, ribs very massive, slightly wider than their interstices, obsoletely granulated at the angulation; interstices transversely very closely, beautifully and regularly striated, old specimens (as the figured type) are very callous and the transverse striation becomes almost obsolete; a very prominent, thick, transverse, rounded keel at the periphery, sculptured like the whorls; $\frac{2}{3}$ of the base sculptured as above, the transverse striation being however more distinct, the remaining $\frac{1}{3}$ round the umbilicus is smooth, the sculpture becoming abruptly obsolete; umbilicus moderate, in old specimens partly covered by the thickened columella, aperture irregularly rounded, margins callous and thickened, slightly reflected over the umbilicus, giving a notched appearance to the columellar margin.

Alt. $2\frac{1}{4}$, diam. $4\frac{3}{4}$ mil.

Pooree, in the Bay of Bengal. Rare.

This handsome species is like no species of the genus as yet described; it perhaps most resembles the West Indian *cancellata* of Marryat, and it is possible that the specimens from the Philippines recorded in the Thesaurus under that name may prove to belong to our species.

Ringicula acuta, Phil.

Mal. Zeits. 1849, (*Aden*).

R. minuta, H. Ad., (*Suez*).

Both var. *minuta* and the larger typical form are extremely common at Aden, in the Gulf of Oman, and at Gwádar on the coast of Persia, as also at Bombay, Ceylon, and Arakan; an allied form (if not the same) was also obtained by one of us at Natal; the largest adult specimen in the Museum measures long. $4\frac{1}{2}$, diam. 3 mil., the smallest long. $1\frac{3}{4}$, diam. 1 mil.; there are also numerous full-grown specimens of many intermediate sizes. Curiously enough, Dr. Stoliczka obtained this species at Singapore, but not *R. Caron*, Hinds. Dr. Armstrong has presented to the Museum a single speci-

men lately dredged alive in Paumben Straits in 39 faths., which must apparently be referred to *R. acuta,* though it is thicker and more callous than any of the Persian Gulf specimens and the striation is entirely obsolete; owing to its much thicker texture and more developed teeth, the aperture is much more contracted; other specimens may eventually prove this form to belong to a distinct species.

Ringicula Caron, Hinds.

Voy. Sulph. 1844, (*Malacca*).

This species also was dredged by Mr. Blanford at Gwádar; it is quite distinct in all its characters from *R. acuta,* the peculiar and very different outer lip, slight development of the parietal tooth, and different texture and striation at once distinguishing it.

Ringicula apicata, Nevill.

J. A. S. B., 1871, (*Mauritius*).

Lately found by one of us at the Andamans rather abundantly; it is only distinguishable from *R. acuta,* Phil. var. *minuta,* H. Ad. by its smooth, polished appearance, having only three striæ at the base of the last whorl, instead of being striated throughout as in the other species; it is slightly narrower and more contracted, less callous, with the teeth more sharply developed.

Ringicula abbreviata, n. sp.

Closely allied to *R. Caron,* Hinds; it has the same regular striation throughout and peculiar corrugated or crenulated outer lip, but has only $3\frac{1}{2}$ whorls, the spire being strikingly short and truncated in appearance; there is no tooth within the outer lip, the parietal tooth is strongly developed, the callosity is extremely broadly reflected on the lower part of the columella and is rugose and sub-obsoletely granulose, there are two teeth on the columella, the lower one of which in some specimens is bifid.

Long. 3 (of which the last whorl alone measures $2\frac{1}{2}$), diam. $2\frac{1}{2}$ mil.

Balapiti in Ceylon, rather common.

(Coll. Indian Museum and H. Nevill).

Trochus (Tallorbis) roseola, Nevill.

J. A. S. B., 1869, (*Ceylon*).

T. (*Euchelus*) *Lamberti*, Souv., J. de C. 1875, (*N. Caled.*)

That M. Souverbie should have overlooked our original description of this remarkable form is unaccountable, the more so that the figure is an excellent one, and that the description, as indeed does the name also, indicates the peculiar colouration of the shell. It may be well to take this opportunity of stating, that we have found in our Indian seas the greater

part of the new marine species described from New Caledonia by M. Crosse and Souverbie; for instance, we had prepared a description of a new *Euchelus* found by one of us alive at extreme low water on a reef at Port Blair, Andaman Islands; on receipt, however, of No. 1 of the Journ. de Conch. for 1875, we found the same species admirably described and figured by M. Souverbie from N. Caledonia, under the name of *Trochus* (*Euchelus*) *fossulatulus*.

Trochus Satrapius, v. Mart.

Nov. Conchol. Sup. V, (*Bushire*).
T. (*Clanculus*) *Tonnerrei*, Nevill, J. A. S. B., 1874, (*Aden*).

The specimen described by v. Martens is considerably bigger than any found by us at Aden; in other respects they seem to be exactly similar; the denticulations at the base of the columella and within the outer lip were not sufficiently marked in our figure, though properly recorded in the description. When we published our species the part of the Nov. Conch. containing the above description had not reached Calcutta.

Trochus (Gibbula) Holdsworthana, Nevill, var.

J. A. S. B., 1871, (*Ceylon*).
Minolia variabilis, H. Ad., P. Z. S., 1873, (*Persia*).

This small variety was dredged tolerably abundantly in tho Gulf of Oman by Mr. Blanford. After a close and careful examination we can detect no difference from the type form, except in the considerably smaller size of the Persian Gulf shell; we must, however, state that in this respect we have seen no intermediate specimens. The Museum possesses typical specimens of *G. Holdsworthana* from Penang, as well as from Ceylon.

In a collection of shells, numbering some 600 or 700 species, dredged by Mr. W. T. Blanford off the coast of Persia, and presented by him to the Indian Museum, are specimens of the following interesting shells: a single specimen of a species of our genus *Robinsonia*, perhaps our *R. Ceylonica;* a new species of *Niso* and our *N. pyramidelloides* (the latter was also dredged in the Paumben Straits by Dr. Armstrong); *Rissoina Stoppanii* and *R. Bellardii* of Issel, with ten other species of the genus; *Fossarus Stoliczkanus*, nobis, and three new species of the genus; *Rimula propinqua*, A. Ad.; a new species of *Limaea*, very close to the European species; *Eucharis angulata*, H. Ad. and *Neæra pulchella*, H. Ad., &c.

It may perhaps be well to record here that specimens of *Macrochlamys Geoffreyi*, H. Ad. (P. Z. S., 1868, p. 290) are marked in the collection of

the Jardin des Plantes at Paris, as *Helix nulla*, Fér., *H. setiliris*, Bens. as *H. turbida*, Fér, *H. argentea*, Rv. as *delibata*, Fér. (also Beck, p. 31, No. 6, without description) and a variety of the same as *carinifera*, Fér.,—all from Bourbon; *H. stylodon*, Bens. as *depressa*, Fér., from Mauritius; (compare Prod. No. 314) *H. pedina*, Bens. (A. and M. 1862, from Bombay) as *H. vitrinoides*, Desh. (Mag. de Conch. 1830), "collected at Bombay in 1835 by Dussumier"; and *Hyalimax Maillardi*, Fisch. as *Succinea unguicula*, Val., from Bourbon. There are also specimens marked as *H. ochroleuca*, Fér. (loc. ?): an examination of pl. 30, fig. 1, Hist. des Moll., proved beyond doubt that this name was given to the Mauritian shell described Mr. H. Adams (P. Z. S., 1869) from our specimens as *H. rufozonata;* the Bermuda species must, therefore, receive a new name.

EXPLANATION OF THE PLATES.

Pl. VII.

Fig. 1. *Mangelia fulvocincta*, p. 85.
2. ——— *Fairbanki*, p. 85.
3. *Clathurella apiculata*, Montr., p. 88.
4. ——— *Malleti*, Recl., p. 89.
5. ——— *perplexa*, p. 89.
6. ——— *nigrocincta*, Montr., p. 89.
7. ——— *Masoni*, p. 90.
8. ——— *Martensi*, p. 91.
9. ——— *enginæformis*, p. 91.

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XII.—List of Mammalia *collected by the late* Dr. Stoliczka *when attached to the embassy under* Sir D. Forsyth *in Kashmir, Ladák, Eastern Turkestan, and Wakhán, with descriptions of new Species.—By* W. T. Blanford, *F. R. S., F. Z. S.*

(Received July 30th;—Read August 4th, 1875.)

The collections made by Dr. Stoliczka in Kashmir, Ladák, Káshghar, and Wakhán comprise a very fine series of mammalia, the description of which has been entrusted to me by Mr. Hume, who has undertaken the general direction, besides a large share in the details, of a work intended to be a memorial of our late friend. It is of course impossible to supply the place of the naturalist whose collections I shall do my best to describe, for with him has perished much knowledge of the habits and distribution of the animals, and although this want can be partially atoned for by the copious notes he has left behind, much unfortunately can never be replaced. In the present paper I shall merely give a list of the species of mammalia represented in the collections, with short characters of those which appear to be new, reserving all detailed descriptions for the larger work, in which it is intended to illustrate all the novelties and imperfectly known forms as fully as possible.

There is always more difficulty in procuring specimens of mammalia than in collecting terrestrial animals belonging to most of the other classes of vertebrata and invertebrata, and this is especially the case with the larger forms. It is consequently not to be expected that the species represented will be more than a portion of those inhabiting the country. Still the collection is rich in some respects, and especially in kinds of rodents, and it adds largely to our knowledge of the fauna of Western Tibet and Eastern Turkestán. The larger mammals indeed were originally better represented, but after Dr. Stoliczka's death many specimens appear to have been removed from the collection. Such at least was the case with the ruminants. In a private letter which Dr. Stoliczka wrote to me, he told me he had sent 22 skins of wild sheep from Káshghar. Of these only 11, 7 males and 4 females, are now forthcoming, and not one of these has fine horns. There is not a single specimen of *Ovis Poli* from the Pámir, the original locality, although I have reason to believe that Dr. Stoliczka brought away one head at least. Lastly, there are skeletons of wild sheep and ibex in the collection, of which the heads have disappeared. It is highly probable that other specimens besides those of *Ovis Poli* have been similarly made over to private individuals. The value of the collection for scientific purposes has been seriously diminished by its being broken up, and the finest specimens distributed, before it had been examined.

For convenience the country traversed may be divided into the Kashmir valley, Ladák, the Kuenluen range south of Yárkand (Karakâsh valley, Sanjú Pass, &c.), the plains of Eastern Turkestan around Yárkand and Káshghar, the ranges north of Káshghar, being spurs from the Thian-shan range, the Pámir, and Wakhán.

The examination of the bats collected has been undertaken by Mr. Dobson, who will describe them separately.

INSECTIVORA.

1. Erinaceus albulus.—Plains of Eastern Turkestan.

2. Sorex (Crocidura) myoides, sp. nov.

S. *parvus, murinus, subtus albescens, pedibus albidis, pilis brevibus sparsis indutis, caudâ supra fuscâ, subtus albescente, setis brevissimis confertim annulatâ, pilisque longiusculis hic inde instructâ, auribus mediocribus, rostro subtus albido. Long. corporis cum capite* 2.1, *caudæ* 1.5, *pedis posterioris cum tarso* 0·5, *auris* 0·22 *poll. angl.*

Hab.—Leh, Ladák.

CARNIVORA.

3. Felis lynx.—Skins purchased at Káshghar.

4. F. sp. near *F. pardinus* (*? Chaus caudatus*, Gray).—Skin purchased as Káshghar.

5. F. uncia.—Ladák; Pámir ?

6. Canis lupus.—Skins purchased at Káshghar.

7.* C. sp. nov. near *C. aureus* but larger.—Skin purchased at Káshghar.

8. C. (Vulpes) montanus.—Ladák (purchased); plains of Yárkand.

9.* C. (Vulpes), sp. immature.—Skin purchased at Káshghar.

10.* Meles, sp. nov.—Skin purchased at Káshghar.

11. Martes foina ?—Skin purchased at Yárkand.

12. M. sp. (? M. abietum, var.).—Skin purchased at Leh.

13. Mustela vulgaris ? var.—Purchased at Yárkand.

RODENTIA.

14. Pteromys inornatus.—Kashmir.

15. Arctomys aureus, sp. nov.

A. *aureo-fulvus, dorso nigro lavato, capite antice fulvescenti-cano, maculo fusco ad rostri extremitatem signato, ventre interdum leviter ferru-*

* These species are probably new but it is not thought advisable to propose names on the evidence of imperfect skins.

ginescente, caudâ tertiam partem corporis capitisque æquante, fulvâ, nigro breviter terminatâ ; pilis elongatis corporis omnibus ad basin fuscis. Long. a rostro ad basin caudæ circiter 18 (*in corio dessiccato*), *caudæ vertebrarum* 6, *palmæ* 2, *plantæ fere* 3, *cranii* 3·7 *poll.*

Hab.—Kaskasu pass between Yárkand and Sarikol, east of the Pámir.

This is a much smaller species than *A. caudatus*, which it resembles somewhat in colour, but it is never apparently so ferruginous beneath, nor so black above as are some specimens of the Kashmir marmot. The tail in *A. aureus* too is rather shorter in proportion. It appears to resemble *A. Hemachalanus* (Hodgson *nec* Anderson) but to be larger and different in colour. The skull shews distinctions from all these forms.

16. Arvicola Blythi.

Phaiomys leucurus, Blyth, J. A. S. B. 1863, XXXII, p. 89 (nec *Arvicola leucurus*, Gerbe).

Arvicola *fuscescenti-fulvus subtus isabellinus, caudâ fulvâ, quartam partem totius longitudinis subæquante vel excedente, auribus rotundatis mediocribus, sparsim pilosis, palmis pentadactylis, ungue pollicari parvo obtuso, dentibus molariis similibus iis* A. mandarini, *molario ultimo maxillari postice magis producto, angulo interno postico ejusdem acutiore, dente anteriore mandibulari antice angulo fortiore interno munito. Long. sine caudâ* 4—4·5, *caudæ* 1·25—1·35, *cranii* 1, *auris* 0·4, *plantæ* 0·8 *poll.*

Hab.—Ladák.

The genus *Phaiomys* of Blyth cannot, I think, be separated from *Arvicola*, as the only character of any importance, the presence of a claw on the rudimentary thumb of the forefoot, is found in many *Arvicolæ*, the common water rat, *A. amphibius*, amongst others. The name *A. leucurus* is objectionable in the present case as the species has not a white tail, and the same specific term had been previously applied by Gerbe to a vole inhabiting the French Alps, but considered by Blasius identical with *A. nivalis*.

17. Arvicola Stoliczkanus, sp. nov.

A. *supra læte fusco-rufescens, sive sordide ferrugineus, subtus albus ; vellere molli, longiusculo, ad basin schistaceo, palmis tetradactylis, plantis pentadactylis nudis brevibus, tarsis subtus pilis indutis, auriculis parvis e vellere haud emergentibus, rotundatis, caudâ quintam partem totius longitudinis subæquante, pilis fulvescenti-albidis setosis instructâ ; dente molario maxillari ultimo angusto, intus angulis duobus fortioribus antice, nullis postice, extus quatuor parvulis, duobus antice, ceteris postice, spatio interveniente, munito. Long. a rostro ad basin caudæ* (*in corio dessicato*) 4, *caudæ* 1, *tarsi* 0·7 *poll.*

Hab.—Nubra valley, Ladák ; Aktágh near Karakoram Pass.

In colour this species approaches *A. russatus* of Radde, but that is said to have the tail tawny above, and the teeth are described as very different. The last upper molar in *A. Stoliczkanus* is peculiarly formed, the anterior portion having two strong salient angles inside, and two very weak ones outside, this is followed by an elongate process with two slight angles outside and none inside, the whole tooth being much elongated.

18. NESOKIA INDICA.—Kashmir.

19. CRICETUS (CRICETULUS) PHÆUS, var.—Kuenluen range north of Sanju pass, Pámir, and Wakhán.

20. C. (CRICETULUS) FULVUS, sp. nov.

C. *peraffinis* Criceto phæo, *sed major atque magis fulvus, arenaceo-fulvus vix cinereus. Long. corporis capitisque* 4·5, *caudæ* 1·4, *auris* 0·75, *tarsi* 0·7 *poll.*

Hab.—Plains of Eastern Turkestan, Pámir, and Wakhán.

Another form of the *phæus* group of hamsters intermediate in size between *C. phæus* and *C. isabellinus.*

21. MUS CRASSIPES ?—Tankse, Ladák.

22. MUS PACHYCERCUS, sp. nov.

M. *affinis* M. Bactriano, *sed minor, caudâ breviore, crassiusculâ, setosâ, supra fusco-fulvus, subtus albidus, auribus ovalibus majusculis, pilosis, Long. (exempli in spiritu vini conservati) a rostro ad basin caudæ* 2·3, *caudæ* 2, *auris* 0·5, *plantæ* 0·65 *poll.*

Hab.—Plains of Eastern Turkestan.

This is apparently the common house-mouse of Eastern Turkestan and differs from *M. Bactrianus* of Afghanistan, Persia, and North-western India, by having a shorter, thicker tail and a differently shaped and larger skull. The colour is sandy brown.

23. MUS SYLVATICUS, var.—Káshghar; Panja in Wakhán.

24. GERBILLUS CRYPTORHINUS, sp. nov.

G. *supra rufescenti-arenaceus, subtus albus, coloris dorsalis ventralisque limite bene notato ;* rostro in lobum semicircularem intus pilis brevibus sparsis indutum, nares obtegentem, desinente; *caudâ corporis capitisque longitudinem excedente, cum dorso superne fere concolore, sed magis rufescente, nisi apicem versus, ubi nigrescit, subtus pallidiore, pilis nonnullis ad apicem caudæ longioribus nigrescenti-fuscis, auribus mediocribus, ovalibus, extus antice dense pilosis, mystacibus confertis, capitem longitudine parum*

excedentibus, supremis nigris, cæteris albis ; vellere longiusculo, molli, nitido, basin versus ad tergum schistaceo ; palmis subnudis, pilis sparsis indutis, plantis confertissime pilosis ; dente molario ultimo simplici, incisoribus unisulcatis. Long. exempli majoris nuper occisi a rostro ad basin caudæ 5·5, *caudæ* 6·25, *auris* 0·75, *pedis posterioris a calcaneo* 1·4 *poll. Long. exempli minoris* 4·5, *caudæ* 5 *poll.*

Hab.—Plains of Eastern Turkestan.

This form is distinguished from all others with which I am acquainted by the peculiar flap at the end of the snout covering the nasal apertures. This flap is semicircular in form, and hairy inside. I can find no description of a similar appendage in any other species, and there is nothing of the kind in *G. Indicus*, *G. Hurrianæ*, or in two undescribed species from Persia and Baluchistan, of all of which I have examined specimens preserved in spirits.

G. cryptorhinus is coloured like *G. meridianus*, but is of the same size as *G. tamaricinus*. From both the above species and from their ally, *G. collium*,* which inhabits western Turkestan, the present species is distinguished by the tail being longer than the body.

Another peculiarity of *G. cryptorhinus* is that the lachrymal bone appears never to be ankylosed to the skull. Consequently the process of the lachrymal which in all true *Gerbilli* projects into the anterior angle of the bony orbit, is frequently absent from the whole bone being lost. This was the case in two skulls which I examined.

25. Dipus lagopus.—Plains of Eastern Turkestan.

26. Lepus pallipes ?—Ladák.

27. L. Tibetanus ?—Nubra valley, Ladák.

28. L. Yarkandensis.

Günther, Ann. and Mag. Nat. Hist., September, 1875, 4, XVI, p. 229.

L. *parvus, affinis* Lepori tolai, *sed multo minor, nusquam niger nec griseus, auribus usque ad apicem concoloribus, haud nigris, arenaceo-isabellinus, fusco plusve minusve ad dorsum lavatus, lateribus lacteis, pectore pallidissime rufo, caudâ albâ, superne fuscâ ; vellere molli, longiusculo, ad basin cinereo. Long. a rostro ad basin caudæ* 17, *capitis* 3·6, *caudæ* 4, *auris* 4·25, *tarsi* 4·25 *poll.*

* For translations of the characters of this and of some other species described in Russian by Severtzoff in his Turkestanskie Jevotnie, I am indebted to the kindness of Dr. Feistmantel. No translations are given in the "Zoological Record," and in the "Archiv für Naturgeschichte" even the names are omitted. It is greatly to be regretted that M. Severtzoff does not, like all the best naturalists amongst his countrymen, describe in a language more generally understood.

Hab.—Plains around Yárkand and Káshghar.

This species approaches *L. tolai,* Pallas, but is much smaller, with proportionally longer ears, and is chiefly remarkable for having no black on the tips of the ears, nor on the tail, and no grey tint on any part of the body.

29. L. Pamirensis, Günther, l. c.

L. supra arenarius vel fusco-isabellinus, infra albus, uropygio albescenti-cinereo ; caudâ superne nigrâ ; aurium marginibus superioribus extus nigris ; pectore pallido rufo ; vellere denso, molli, ad basin, præter ventrali, cinereo ; pilis longioribus ad dorsum nigro-terminatis, intermixtis. Long. a rostro ad basin caudæ circiter 18, *caudæ* 4, *auris a basi anticâ* 5, *ejusdem latitudo* 2·75, *cranii longitudo* 3·5, *tarsi* 5 *poll.*

Hab.—Banks of Lake Sirikul, Pámir.

This is distinguished from the last by being somewhat larger, by having the ends of the ears and the upper part of the tail black, and by its grey rump. It is near to *L. Tibetanus* but differently coloured. The ears in the dry skin measure only 3·6 in. from the orifice and 4·5 from the head outside.

30. L. Stoliczkanus, sp. nov.

L. *præcedenti peraffinis, arenario-fulvus, differt tantum auribus multo longioribus, vellere dorsali nigro lavato. Long. corii desiccati a rostro ad basin caudæ* 17·5, *caudæ (vertebrarum)* 3, *ejusdem cum pilis apicialibus fere* 5, *cranii* 3·5, *auris extus* 5·2, *tarsi* 4·9.

Hab.—Hilly country and Thian Shan mountains north-east of Káshghar.

This is rather darker than the preceding species and has much longer ears. When fresh the latter would probably measure over 6 inches. Both this and the last appear to have longer ears than *L. Lehmanni,* Severtzof, in which they are the same length as the head.

31. Lagomys Ladacensis.

L. Curzoniæ, Stol., J. A. S. B., 1865, XXXIV, Pt. 2, p. 108, nec Hodgson.
L. Ladacensis, Günther, Ann. and Mag. Nat. Hist., Sept., 1875, Vol. XVI, p. 231.

L. *major, pallide cervinus, seu rufescenti-fulvus, dorso in æstate magis rufescente, auribus rotundatis, majusculis, extus ferrugineis, velleris dorsalis dimidio basali nigrescenti-plumbeo, apiciali primum rufescente, tunc demum albescenti-isabellino, pilis nonnullis longioribus nigris ad dorsum intermixtis, ventre pedibusque pallide fulvis, capite antice rufescente, vibrissis supe-*

rioribus nigris, inferioribus albis. Long. tota circa 9, *cranii* 2·25, *auris* 1, *tarsi* 1·5 *poll.*

Hab.—Ladák.

This is the common species of northern and north-eastern Ladák but not apparently of the mountains bordering the Kashmir valley. It is easily recognized by its peculiar pale fawn colour, more rufous in summer. It was first described some years ago by Dr. Stoliczka, who referred it to *L. Curzoniæ.* I had occasion subsequently to shew that the true *L. Curzoniæ* of Hodgson is a different species, and I have just heard from Dr. Günther, whilst this paper is passing through the press, that he has named the present form *Ladacensis:* I have consequently withdrawn the name I had proposed to give it. It is allied to *L. ogotona* by the form of the skull.

32. L. AURITUS, sp. nov.

L. *superne sordide fulvus fusco-lavatus, capite humerisque rufescentibus, auribus magnis rotundatis, pilis isabellinis indutis, vellere molli, pilis basin versus nigrescenti-plumbeis, apices versus in dorso lateribusque isabellinis, fusco-terminatis, subtus albis. Long. (in corio dessicato) tota circiter* 7·5, *cranii* 1·8, *auris* 1, *tarsi* 1·2 *poll.*

Hab.—Pangong lake, Ladák.

A larger form than *L. Roylei* with much larger ears. The colour in two skins from Lukung on the Pangong lake is smokey brown. The ears are as large as in the last species and must in the living animal be nearly 1½ inches across.

33. L. GRISEUS, sp. nov.

L. *sordide griseus, subtus albus, ad dorsum frontemque leviter rufescenti-lavatus, vellere elongato, molli, ad basin plumbeo-nigro, apices versus in dorso lateribusque griseo, apicibus ipsis nonnullis fuscis; auribus magnis rotundatis, pilis sparsis albidis indutis. Long. in exemplo nuper occiso* 7, *capitis* 1·75, *auris* 1·4, *tarsi* 1·3 poll.

Hab.—Kuenluen range South of Sanju Pass.

I know of no other *Lagomys* which approaches this in colour. It is a peculiar grey, almost the colour of *Chinchilla.* The skulls of the last and present species approach in character to those of *L. Roylei* and *L. rufescens* but still exhibit well-marked differences.

34. LAGOMYS MACROTIS? Günther, l. c.—Kuenluen range?

The above is a wonderfully rich series of *Leporidæ.*

UNGULATA.

35. Sus scrofa, var. nigripes.

Hab.—Thian Shan mountains near Káshghar.

The two specimens, male and female, closely resemble the European wild boar, but the legs are black, and there are some trifling cranial differences, which, although perhaps insufficient to justify specific distinction, are worthy of notice.

36. Ovis Heinsi?—Thian Shan mountains.

37. O. nahura.—Kuenluen range.

38. Capra Sibirica.—Kuenluen range and Thian Shan mountains.

39. Gazella subgutturosa, var. Yarkandensis.

G. subgutturosa *cornibus lyriformibus juxta caput subparallelis, lente divergentibus; facie fusco valde striatâ.*

Hab.—Plains of Eastern Turkestan.

This differs much from the typical form of *G. subgutturosa*, the horns taking a much less open curve, and the face markings being much darker, but as intermediate forms are found in Persia, I do not separate it.

40. Pantholops Hodgsoni.—Ladák.

41. Cervus, sp. (horns only)—? Thian Shan mountains N. E. of Káshghar.

42. Capriolus pygargus ? (horns only)—Káshghar ?

P. S. *Sept.* 28*th.*—The number of the Annals and Magazine of Natural History for September, 1875, containing descriptions of several species of hares and *Lagomys* by Dr. Günther, was only received just before the last proof of this paper was passed. Although, under the rules usually adopted in England, the names given by myself would have priority, from having been given in a paper read before the Asiatic Society in August, I have thought it best to withdraw them, and to substitute those given by Dr. Günther, in order to obviate any risk of confusion in the nomenclature:

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XIII.—*On the species of* Marmot *inhabiting the Himalaya, Tibet, and the adjoining regions.—By* W. T. Blanford, *F. R. S., F. Z. S.*

(Received July 30th, 1875;—Read August 4th, 1875.)

The distinctions and nomenclature of the Himalayan and Tibetan species of marmot appear to me in need of careful revision. The necessity for investigating the subject during an endeavour to ascertain the name of the Ladák species, and of a new form of which specimens were obtained by Dr. Stoliczka at the Kaskasu pass, on the road from Yárkand to the Pámir plateau, has convinced me that the received synonymy of the two best known species requires reconsideration, and that several of the identifications made by Gray, Blyth, Jerdon, and Anderson are erroneous.

The history of the nomenclature of Himalayan and Tibetan marmots appears to be the following. In 1841,* Mr. Hodgson described a species from the "Kachar" of Nepal and the plains of Tibet under the name of *A. Himalayanus.* In 1843, he redescribed this species and suggested altering the name to *Tibetensis*, and at the same time distinguished a smaller form with a longer tail and somewhat different colouring as *A. Hemachalanus.* From references made at various times to his unpublished catalogue it is probable that *A. Hemachalanus* had originally been called *A. Tibetanus* by Mr. Hodgson, and it appears under that name in the British Museum Catalogue of Mr. Hodgson's collections. In the same year, 1843, Dr. Gray, in the British Museum 'List of specimens of Mammalia', united *A. Himalayanus*,†

* For references see below.

† Under *A. Himalayanus* in this catalogue, after the reference to Hodgson's description, there is added "Griffith, Jour. A. S. B. 1841, 779?" The proper reference is

and "*A. fulvus*, Eversman" to *A. bobac* of Schreber. There is no evidence that these species had ever been compared, and the only specimen stated to exist in the British Museum at the time was said to be from Siberia.

The next addition to the nomenclature was by Jacquemont, who described a marmot from the range north of the Kashmir valley as *A. caudatus*. His description was published, with a figure of the animal, in the appendix by Geoffroy St. Hilaire to Jacquemont's posthumous work, the 'Voyage dans l' Inde,' in 1844.

In the 'Catalogue of the specimens and drawings of the Mammalia and Birds of Nepal and Thibet presented by B. H. Hodgson, Esq. to the British Museum,' the larger or short-tailed marmot is called *A. bobac*, Gmelin, and the smaller *A. Tibetanus*, Hodgson. The same names are preserved in the second edition of the catalogue issued in 1863.

In 1847 the "large Himalayan marmot" was described by Dr. Jameson as *Arctomys Tataricus*. This description appears to have been overlooked by Indian naturalists.

In 1851, Horsfield in his 'Catalogue of the Mammalia in the Museum of the Hon. East India Company' classed both *A. Himalayanus* and *A. caudatus* as synonyms of *A. bobac*.

Omitting several notices of the various Himalayan marmots by travellers, the next noteworthy attempt at discriminating the species was by Adams in 1858. He called the "red marmot" of Kashmir *A. bobac*, and the "white marmot" *A. Tibetanus*. It is evident, I think, that most writers apply the name *A. bobac* to Adams's "white marmot."

Blyth in his catalogue (1863) united all the Himalayan marmots under *A. bobac*, Schreber, giving as synonyms *Mus arctomys*, Pallas (which is the original name of *A. bobac*), *A. fulvus*, Eversman, *A. Tibetanus*, *Himalayanus* and *Hemachalanus*, Hodgson (the last with a note of interrogation, however), and *A. caudatus*, Jacquemont. In a foot note Blyth points out the distinctions between Hodgson's two supposed species, but adds that he cannot satisfactorily discriminate two species in the Society's skins and skulls. Dr. Stoliczka* in 1865 was also disposed to unite the two forms found in the western Himalayas, but he gave no details.

Jerdon, in his 'Mammals of India,' considered that Hodgson was correct in separating *A. Hemachalanus* from the short-tailed form and, consequently,

probably J. A. S. B., X, 1841, p. 978, where mention is made by Dr. Griffith of a marmot, the size of a beaver, found at between 11,000 and 12,000 feet in Afghanistan, at the Hageeguk, Kaloo, and Erak passes. Of this animal no specimens appear ever to have been described, but, as I shall subsequently shew, there is a skull, probably from Afghanistan, in the Society's old collection.

* J. A. S. B. XXXIV, p. 111, note.

distinguished two species ; *A. bobac* (with *A. Tibetanus* and *Himalayanus* of Hodgson and *A. caudatus* of Jacquemont as synonyms) and *A. Hemachalanus.* Fitzinger in his 'Versuch einer natürlichen Anordnung der Nagerthiere' enumerates two Himalayan and Tibetan species of *Arctomys,* which he calls *A. Tataricus,* James. (with, as synonyms, *A. Himalayanus,* Hodgs. *A. bobac,* Gray, and *A. caudatus,* Gieb.) and *A. caudatus,* Isid. Geoffr.

In Dr. Falconer's posthumous 'Palæontological Memoirs' there is an excellent description of the common marmot of Western Tibet with a full account of the animal's habits. He calls the species *A. Tibetana,* and in a note by the editor it is apparently identified with *A. Himalayanus,* an identification which, as I shall shew hereafter, is incorrect.

Dr. Anderson in 1871* distinguished two species of marmot from Ladák and the Kuenluen mountains, one of which he identified as *A. bobac* (with *Mus arctomys,* Pallas, *Arctomys fulvus,* Evers., *A. Himalayanus* and *A. Tibetanus,* Hodgs. *A. caudatus,* Jacquemont, *A. bobac,* Gray, Horsfield, Blyth, and Stoliczka, and *A. Tibetanus,* Adams as synonyms), the other with *A. Hemachalanus* (synonyms—*A. bobac* of Adams and partly of Blyth and Stoliczka).

In 1870, MM. Milne-Edwards described *Arctomys robustus* from Moupin in Eastern Tibet. And I may conclude these notices by a reference to M. Severtzoff's work 'Turkestanskie Jevotnie,' in which *A. baibacinus,* Brandt and *A. caudatus,* Geof. are said to be found in Western Turkestan. Unfortunately the work in question is entirely in Russian and several of the identifications are incorrect, so that it is impossible to feel any certainty as to the animal which Severtzoff has identified with *A. caudatus.* I think it improbable that the Kashmir marmot is really found in Russian Turkestan. It is more probable that the species is the *A. aureus* described on a previous page† from the specimens obtained by the late Dr. Stoliczka at the Kaskasu pass between Yárkand and the Pámir.

I may here state at once that I have reason to believe that, besides *A. robustus,* there are not two, but three species of Himalayan or Tibetan marmots, and that a great part of the confusion in the nomenclature is due to this circumstance.

In the synonymy above quoted one name frequently occurs, which appears to me to have been admitted by mistake. This is *Arctomys fulvus,* Eversman. Blyth gives no reference ; Gray, in the British Museum Cat. p. 148, gives Griffith, A. K. t. 118, and, as Anderson gives precisely the same,

* The title of Dr. Anderson's paper in the Proceedings of the Zoological Society 'On some rodents from Yárkand' is unfortunate, for only two of the four species described had been obtained in Turkestan territory and not one was from the neighbourhood of Yárkand, whilst all four are found in Ladák.

† Ante, p. 109 of this volume.

I suppose there may be such a name in some editions of Griffith's Animal Kingdom, though I cannot find it in the copy in the Society's library. In any case, I have no doubt the species is really *A. fulvus* of Lichtenstein, described in Eversman's 'Reise nach Buchara,' p. 119. That species is a *Spermophilus* and not a true *Arctomys*,* and, consequently, is distinct from all the Himalayan species, none of which, so far as is known, have cheek pouches.

The next point for consideration is what is *Arctomys caudatus* of Jacquemont. As it is described as having a tail two-thirds the length of the body, it is evidently not *A. bobac*,† to which it is referred by Blyth, Jerdon, and Anderson. It is clearly, on the other hand, the same as the species referred by Anderson to *A. Hemachalanus*. Anderson's specimen agrees pretty fairly with Jacquemont's figure and description ; there is more black on the back and tail in the former, and the abdomen wants the ferruginous tint, but neither of these characters is constant. The localities whence the two were procured are close together ; the marmot skin obtained by Dr. Henderson and described by Dr. Anderson being from Matayon, just north (on the Dras side) of the Zogi-la‡, between Srinagar and Leh ; whilst Jacquemont's type was shot at a place which he called Gombour or Gombur, close to the head of the Sind valley, but on the Indus side of the watershed and in the valley of a stream running into the Dras river.

There is a possibility of a second and smaller marmot being found in the Kashmir ranges, for Vigne, Travels in Kashmir &c., II. p. 230, mentions seeing one, as large as a small fox, on the road from Srinagar to Skardo. The animal which I identify with *A. caudatus* is the size of a very large fox.

A skin just received at the Indian Museum from Dr. Aitcheson at Srinagar agrees with that described as *A. Hemachalanus* by Dr. Anderson, except that the back is blacker. Mr. Lydekker informs me that these skins are precisely like those of all the marmots he saw on the ranges north of Kashmir.

Still, however, I am in no way prepared to admit that Dr. Anderson was correct in identifying the Ladak marmot with Mr. Hodgson's *A. Hemachalanus*. The former is a large marmot, one of the largest known species, the skull measuring 105 mm. (4. 12 inches) or as much as *A. robustus*. Hodgson's *A. Hemachalanus* on the contrary must be a small marmot, the body being only 12 to 13 inches long, and the tail $5\frac{1}{4}$ to $5\frac{1}{2}$, the corresponding dimensions (taken from skins) of the Ladak marmot being 22 and

* Brandt, Bull. Ac. Imp. Sc., 1844, II, p. 366.

† This has been noticed by MM. Milne-Edwards, Rech. Mam, I, p. 312.

‡ This name has been converted into Tooglen pass in the P. Z. S. 1871, p. 562.

$10\frac{1}{2}$ inches.* Dr. Anderson concludes that Mr. Hodgson had never seen an adult of *A. Hemachalanus* and that he drew up his description from immature specimens. I do not think this view is probable. Hodgson was careless in matters of nomenclature, as many naturalists were in his time, but he collected largely and studied the animals he described carefully, as is shewn by the minuteness of his descriptions. I scarcely think, had the specimens he described been half grown, that he would have overlooked the evident immaturity of the skulls, which he must have extracted, for he describes the teeth. Moreover, I think Dr. Anderson must have overlooked Mr. Hodgson's remark that he had kept some of the smaller marmots alive for months, one of them for over a year and a quarter. Surely he would have noted their growth during that period. I cannot say how long a marmot may be in attaining its full growth, but if it requires more than a year, it differs greatly in this respect from most rodents.

There are also, I think, some important differences between the colouration of Hodgson's *A. Hemachalanus* and the Kashmir marmot. The former is described as having the general colour "dark grey with a rufescent tinge which is rusty and almost ochreous red on the sides of the head, ears and limbs, especially in summer. Bridge of nose and last inch of tail dusky brown." In the latter the general colour is more yellow, the whole lower parts and the limbs are ferruginous (there appears to be much variation, perhaps sexual, in the colour of the upper parts), the bridge of the nose is not dark, but the tip is, and at least 3 inches at the end of the tail are black.

It is true that Dr. Anderson mentions his having obtained skins purchased at Darjiling which were undistinguishable from the Ladák marmot.† It is probable that these skins had been brought from upper Sikkim, or Tibet, but if so, and if they are correctly identified, the only conclusion I can come to is that these must be three species of marmots in the Himalayas of Sikkim and Nepal.

A. Tataricus I am unable satisfactorily to identify. The reference in Wiegmann's 'Archiv'‡ runs thus "A supplementary description of the large Indian Marmot has appeared by Dr. Jameson, who has applied to it the name of *Arctomys Tataricus* (Inst. p. 384)." The work referred to is

* The length of the tail in the Ladák specimen is without the hair at the end. In Mr. Hodgson's measurement the hair is, I think, included, although its inclusion is not specified, because it is comprised in the corresponding measurement of the tail of *A. Himalayanus* on the same page.

† Mr. Wood-Mason has had search made for these skins, but owing to so many of the Museum specimens having been packed away pending their transfer to the new building, it has not been possible to find them.

‡ 1848, Pt. 2, p. 155.

probably a French one, L' Institut, at least so I infer from the fact of a paper by Gervais quoted with a similar reference in the 'Archiv' being assigned to this magazine in Carus and Engelmann's 'Bibliographia Zoologica'. At the same time neither Jameson's nor Gervais' paper is quoted in the Royal Society's Catalogue, although L' Institut is included in the works catalogued.

There is a short paper by Dr. Jameson on the Zoology of Chinese Tartary in the Calcutta Journal of Natural History,* in which he briefly mentions a marmot which he observed beyond the Niti pass, and of which he says that it is of a reddish yellow colour and the size of a rabbit. I know of no Himalayan marmot which when adult is so small as a rabbit; the smallest species is *A. Hemachalanus*, and possibly this may have been the animal observed by Jameson, but in Weigmann's 'Archiv' he is said to have described the *large* Indian marmot: of course it does not follow that the species seen by him north of the Niti Pass was the same which he subsequently named *A. Tataricus.* Meantime the identification is of less moment, because in all probability the species named by Jameson was either *A. Himalayanus*, *A. Hemachalanus*, or *A. caudatus*, all of which names have priority over *A. Tataricus.*

But the most important point of all is the identification of the short-tailed Himalayan marmot with *A. bobac.* This apparently was made by Gray without his having examined specimens of *A. Himalayanus;* and Blyth, Jerdon, and Anderson, so far as I know, had never seen examples of the true *A. bobac*, so that I doubt if the species have ever been compared. Pallas (Zoog. Ros. As. I, p. 155) united all the known† Asiatic marmots without cheek pouches to the *Bobac*, which he called *Arctomys Baibàk*, but he described the Kamschatkan race as a well marked variety. Brandt (Bull. Ac. St. Pet. 1844, II, p. 364) separated this Kamschatkan form as a distinct species, which he called *A. Camschatica*, but which he suggested might be identical with the American *A. monax*, and he indicated another species from the Altai under the name of *A. baibacina*, which, however, he did not describe.‡ Severtzoff quotes this species *A. baibacinus* from western Turkestán. Without attaching much importance to this circumstance for the reasons already mentioned, I think it yet remains to be shewn that the true *A. bobac* of Schreber, *Mus arctomys* of Pallas, is found in Central Asia at all. The name was originally applied to the marmot of Poland and

* Vol. VII, p. 360.

† Of course no Himalayan marmots had been described in 1811 when Pallas's work was first published.

‡ He appears to have described it subsequently in a paper on the vertebrata of Siberia, which I cannot find. It is mentioned by Milne-Edwards in Rech. Mam. p. 311, note.

Galicia, which appears to be a much smaller animal, weighing 8 to 10lbs., the body being 16 inches, the tail 4 inches 4 lines, or including the hair 5′ 4″ long, whereas in *A. Himalayanus* the head and body measure 22 to 24 inches, and the tail $6\frac{3}{4}$ with the hair according to Jerdon, $5\frac{1}{2}$ to $6\frac{1}{4}$ according to Hodgson. Pallas's original measurements of *A. bobac*, which I quote above,* are probably in French inches, which would render the difference rather less, but still it is very considerable.

Pallas's original description of the colour of *A. bobac* runs thus: *Color rostro et circa oculos magis minusve fusco-nigricans, inter mystaces subferrugineus; parotides pallidæ, gula ferruginea, reliquum corpus infra et artus interiore latere ferrugineo-lutescentia; supra gryseus, pilis longioribus nigris, vel fuscis apice gryseo-pallidis magis minusve inumbratus. Cauda basi subtus ferruginea, majore parte lutescens, a medio picea, apice atra.* The animal referred to *A. Himalayanus* does not differ greatly in colour from Pallas's description. MM. Milne-Edwards,† however, point out that *A. bobac* is a very much paler animal than *A. robustus*, which appears closely to resemble *A. Himalayanus*, and may perhaps be the same.

On the whole I think it is far safer for the present to keep *A. Himalayanus* distinct from *A. bobac*. I have not sufficient materials at present to determine whether the short-tailed marmot of the Kuenluen and Ladák is absolutely identical with the type of *A. Himalayanus*, but it appears to correspond fairly and I know of no distinction.

The figure of *A. robustus* in the 'Recherches sur les Mammifères' is much more richly coloured than *A. Himalayanus* is, but the authors of the work point out that the plate is over-coloured. The species are evidently very closely allied and may possibly be identical. The skulls are very similar, the nasals being a little shorter in *A. robustus*, and the point of bifurcation of the sagittal crest further back, but there is a possibility that these differences may be due to age, and it is evident from the state of the teeth that the figured skull of *A. robustus*, although apparently full grown, is younger than that of *A. Himalayanus* which I have compared with it: this skull of *A. Himalayanus* is from one of the skins brought by Dr. Henderson from the Sanju Pass, Kuenluen range. There are, however, some little differences in the form of the zygomatic arch, &c., and especially in the relation of the longitudinal to the transverse diameter, which make me hesitate to consider the two the same.

In trying to throw some light upon this question of the Himalayan marmots, I have examined the following specimens.

I. Four skins with skulls of *A. aureus* from the Kaskasu Pass.

* Glires, p. 113.

† Recherches Mam. p. 311.

II. Three skins of *A. Himalayanus* (the same as examined and described by Anderson) from Kitchik Yilak, close to the Sanju Pass in the Kuenluen range, south of Yárkand ('Lahore to Yarkand,' p. 101).

III. A skin of *A. caudatus* (the same as described by Anderson as *A. Hemachalanus*) from Matayon on the Zogi-la near Drás between Kashmir and Ladák, and a flat skin of the same probably from Kashmir; also a skull of the same brought by Mr. Lydekker from the range north of Kashmir.

IV. The specimens made over by the Asiatic Society to the Indian Museum, three stuffed skins, a skeleton, and two skulls, all enumerated in Blyth's Catalogue*. These require a few words of notice. By both Blyth and Anderson the whole have been referred to *A. bobac* (*i. e. A. Himalayanus*). Two stuffed specimens (one of them young and both with imperfect tails) which were presented by Mr. Hodgson, probably belong to this species. The other specimens are a stuffed skin and the skeleton from an animal brought alive to Calcutta from Sikkim, and two skulls, one presented by Lieut. Brownlow, who probably procured it in the western Himalayas, and the other from the Burnes collection, and, therefore, it may be expected, from Afghanistan. I have carefully examined the three skulls and am convinced that they belong, in all probability, to three different species, that of the skeleton differing widely from both the others in the form of the palate and of the nasal bones, in the length of the sagittal crest and the point of its bifurcation, whilst of the two remaining one is much larger than the other, besides other differences. The skeleton is evidently that of a fully adult animal. It measures from snout to insertion of tail 15 inches along the curve of the back, the tail vertebræ $4\frac{1}{2}$. This is very close to the measurement of *A. Hemachalanus*, and the skin agrees with the description of that species in having the frontal portion of the face dark brown. The fur is short and thin, but it is scarcely probable that the fur of a marmot which had lived for months in Calcutta would retain its original character. I think it highly probable that this specimen really belongs to *A. Hemachalanus*. It certainly does not agree with *A. Himalayanus*.†

The skull presented by Lieut. Brownlow is, I find by comparison, that of *A. caudatus*. The Burnes' collection skull, although somewhat resembling that of the new species *A. aureus*, appears to me to belong to a

* Cat. Mam. Mus. As. Soc., p. 108.

† I should add, that in these specimens, as in all other skins either of birds or mammals, which have been exposed to the light for many years in Calcutta, the colours have faded greatly, and in all the mammals the texture of the fur appears to have changed, becoming much harsher. I think it much to be regretted that small mammals should be mounted at all; as a rule valuable skins and types should be kept unmounted in drawers, and not exposed.

different and probably undescribed species, which should be looked for in Afghanistán. It is very possibly the form mentioned by Dr. Griffith as seen by him at the Hageeguk, Kaloo, and Erak passes,* and also briefly referred to in Sir Alexander Burnes' 'Cabool.'†

It is useless to refer to the various notes by travellers, on the marmots observed by them, in the hope of ascertaining the distribution of the different species, since the external differences are, as a rule, not sufficient to render the brief descriptions given characteristic of any particular kind, and the task of determining the exact range of each species must be left to future research. I shall conclude this paper by giving the names and the synonymy, so far as I have been able to unravel it, of the four species, the existence of which in the Himalayas and the neighbouring ranges to the north-west I consider probable, merely adding that in all probability another species, hitherto undescribed, inhabits Afghanistan. I am quite at a loss to conceive what is the form with large ears represented in Hooker's 'Himalayan Journals,'‡ and which is said to migrate sometimes in swarms from Tibet to Upper Sikkim. Certainly, no known Himalayan marmot approaches this animal in the structure of the ears§.

Section 1.—*Short-tailed marmots having the tail less than one third the length of the head and body.*

1. Arctomys Himalayanus.

A. Himalayanus, Hodgson, J. A. S. B., 1841, X, p. 777.

"*A. Himalayanus* of Catalogue, potius *Tibetensis* hodie," Hodgs., J. A. S. B., 1843, XII, p. 409.

"*A. bobac*, Schreb." *partim*, Gray, List of the specimens of Mammalia in the collection of the British Museum, 1843, p. 148, *nec* Schreber.

"*A. bobac*, Gmelin", Gray, Cat. spec. &c. Mammalia and Birds of Nepal and Thibet presented by B. H. Hodgson, Esq. to the British Museum, p. 23, (1846) ; *nec* Gmelin.—— Ib. 2nd Edition, p. 12, (1863).

? *A. Tataricus*, Jameson, L'Instit. 1847, XV, p. 384.

"*A. bobac*, Schreb." Horsf. Catalogue of Mammalia in the India House Museum, p. 164, (1851) ; *nec* Schreber.

"*A. Tibetanus*, Hodgs." white marmot of Europeans, Adams, P. Z. S. 1858, p. 521.

"*A. bobac*, Schreb." *partim* Blyth, Cat. Mam. Mus. As. Soc., p. 108, (1863) ; *nec* Schreber.

"*A. bobac*, Schreb." Jerdon, Mammals of India, p. 18, (1867), *nec* Schreber.

"*A. Tataricus*, Jameson," Fitzinger, Sitzungsb. k. Ak. Wiss. Wien, 1867, LV, 1, p. 491.

* See note on page 114.

† p. 163.

‡ Vol. II, pp. 109, 170, smaller edition.

§ I cannot help feeling some doubt as to whether the animal figured is a marmot at all.

A. robustus, H. and A. Milne-Edwards, Nouv. Arch. du Musée, VII, Bull. p. 92 (1870).—Recherches sur les Mammifères, I, p. 309, Pl. XLVII, XLIX.

"*A. bobac*, Schreb." Anderson, P. Z. S., 1871, p. 560, *nec* Schreber.

General colouration greyish fulvous, beneath yellow, hair of the back with very short black tips, tail dark brown at the end. Length 22 to 24 inches, tail with hair at the end 5½ to 6½.

Hab.—Tibet : Ladák : Kuenluen south of Yárkand.

Section 2.—*Marmots with tails one third or more than one third the length of the head and body.*

2. Arctomys Hemachalanus.

A. Hemachalanus. Hodgs., J. A. S. B. 1843, XII, p. 410.

"*A. Tibetanus*, Hodgs.," Gray, Cat. Mam. Birds Nipal, p. 24, (1846)—2nd Edition p. 12, (1863).

"*A. bobac*, Schreber" *partim*, Blyth, Cat. Mam. Mus. As. Soc. p. 108, (1863), *nec* Schreber.

"*A. hemachalanus*, Hodgson," Jerdon, Mam. Ind. p. 182, (1867).

"Colour dark grey with a full rufous tinge, which is rusty and almost ochreous red on the sides of the heads, ears and limbs, especially in summer. Bridge of nose and last inch of tail dusky brown. Length 12 to 13 inches tail (with hair) 5¼ to 5½".*

Hab.—Sikkim and Nepal, in the higher regions of the Himalayas.

3. Arctomys caudatus.

A. caudatus, Jacquemont, Voyage dans l' Inde, Vol. IV, Zoologie, p. 66, Atlas, Vol. II, Pl. 5, (1844).

"*A. bobac*, Schreber," red marmot of Europeans, Adams, P. Z. S., 1858, p. 521, *nec* Schreber.

"*A. bobac*, Schreber," *partim* Blyth, Cat. Mam. Mus. As. Soc. p. 108, (1863), *nec* Schreber.

"*A. bobac*, Schreber," *partim*, Jerdon, Mam. Ind. p. 182, (1867), *nec* Schreber.

"*A. caudatus*, Isid. Geoff.," Fitzinger, Sitzungb. k. Ak. Wiss. Wien, 1867, LV, 1, p. 491.

A. tibetana, Falconer, Palæontological Memoirs, I, p. 583, *nec A. Tibetanus*, Hodgs.

"*A. hemachalanus*, Hodgson", Anderson, P. Z. S. 1871, p. 561, *nec* Hodgson.

Colour rich rufous yellow when adult, more or less black on the back : sometimes the back is black throughout : lower parts with a strong ferruginous tinge ; tail black for the greater portion of its length. Head and body about 25 in., tail with hair 13, or more than half the length of the body.

Hab.—Mountains north of Kashmir : Ladák.

* These are Hodgson's measurements, but I anticipate that the animal grows to a larger size, to judge by the skull, which is as large as that of *A. aureus.*

4. Arctomys aureus.

A. aureus, W. Blanf., ante, p. 106.

On a previous page I described this species very briefly. The following is a fuller account, taken from four specimens, three brought by Dr. Stoliczka and one by Captain Biddulph from the mountains west of Yárkand.

General colour tawny to rich brownish yellow, the dorsal portion conspicuously tinged with black from all the hairs having black tips, but these are far more conspicuous in some specimens than in others; face grey to blackish with a rufous tinge, covered with black and whitish hairs mixed, which are about half an inch long on the forehead, the black hairs more prevalent in some specimens, apparently males, than in others; the middle of the forehead sometimes more fulvous. Just on the nose is a blackish brown patch, and there is a narrow band of short black hairs mixed with white around the lips: sides of the nose paler; whiskers black. Hairs of the back $1\frac{1}{4}$ to $1\frac{1}{2}$ inches long, dark slaty at the extreme base for about $\frac{1}{4}$ inch, then yellow, becoming deeper golden yellow towards the extremity, the ends black. In the blackest specimens (? males) the posterior portion of the back wants the black tips. Tail the same colour as the back, except the tip, which is black; the length of the black tip varies, but never exceeds about $2\frac{1}{2}$ inches in the specimens before me, and in three out of the four it is only about an inch: hairs of the tail about 2 inches long, brown at the base. Lower parts rather browner, the hairs shorter and thinner, chocolate brown at the base, without the short woolly under-fur, which is very thick on the back. Feet above yellowish tawny like the sides.

Length taken on the dried skins:

Nose to insertion of tail,	16·5 to 18·75
Tail, without hairs at the end,	5 to 6·5
Hairs at end of tail,	1·5 to 1·75
Fore-foot (palma) to end of toe, without claws,	2·05
Mid toe, without claw, measured below,	0·8
Claw, measured above,	0·6
Hind foot (planta) to end of toe, without claws,	2·9
Mid toe, without claw,	0·8
Claw of do., measured above,	0·52

This is a very much smaller animal than *A. caudatus*, and its tail appears shorter in proportion and with less black. The colour of the lower parts is less rufous and the feet are tawny yellow, not ferruginous as in the larger form. The fur of *A. aureus* too is softer. From *A. Himalayanus* the present species is distinguished by its much longer fur, by being much yellower in tint and less grey, and by its longer tail. It is also much smaller. From *A. Hemachalanus* it may be recognised by its longer tail and richer colouration.

The following are the dimensions of skulls of all the above species in parts of a metre, those of *A. robustus* having been taken from the figures. I also add the measurements of the skull of a specimen of *A. bobac* belonging to the Berlin Museum.

	A. Himalayanus. (Kuenluen).	*A. Himalayanus.* (North of Sikkim).	*A. robustus.*	*A. Hemachalanus.*	*A. caudatus.*	*A. aureus.*	*A. bobac.*
Length from occipital plane to anterior end of nasal bones,......	·105	·101	·104	·093	·105	·094	·0885
Breadth across widest part of zygomatic arches, ...	·0655	·0675	·065	·061	·066	·057	·059
Do. behind postorbital processes,	·019	·019	·019	·020	·016	·017	·0165
Length of nasal bones,..........	·045	·040	—	·038	·042	·038	·038
Breadth do. behind,	·010	·013	·011	·011	·017	·0105	·0105
Do. do. in front,	·018	·018	·015	·016	·020	·0165	·0155
Length of row of upper molars, ..	·025	—	·025	·024	·0235	·020	·0215
Do. lower jaw from angle to alveolar margin, ...	·069	·070	·069	·064	·074	·066	·0625
Height of do. at coronoid process,	·0425	·039	·037	·036	·041	·035	·036

P. S.—*Oct. 28th.* Some months have elapsed since the above paper was written, and in the meantime, through the kindness of several friends, I have been enabled to add materially to the evidence as to the distinctions of the different species of marmots.

In the first place, I am indebted to Professor Peters of Berlin, who, with great kindness and liberality, has sent a skin and skull of *Arctomys bobac* belonging to the Berlin Museum for examination. In its external characters this animal differs widely from *A. Himalayanus.* It is a sandy-grey animal with a brown wash, without a single black hair on its body, the hairs on the back being dusky at the base, then dirty white, and the tips of the longer hairs on the back and sides being brown. The lower parts throughout shew a ferruginous tinge. The terminal portion of the tail is brown. This skin measures from nose to rump 21 inches, tail 5½; but it is very much smaller than *A. Himalayanus.*

Of course this specimen may have faded and the tips of the hairs may have been black originally, as in Pallas's description, but there is nothing in the character of the skin to render this supposition probable, and if the tips of the hair had become paler, I should hardly have anticipated that they would have done so to precisely the same extent throughout the body. Moreover, the skin before me coincides closely with the figure in Schreber's Säugethiere, Pl. CCVIII, and with Messrs. Milne-Edwards' description.

Professor Peters tells me that the skin sent is from Siberia, and that he has endeavoured for years in vain to procure a Polish or Galician specimen.

Compared with the skins of *A. Himalayanus*, this specimen of *A. bobac*, besides being paler and having brown instead of black tips to the long dorsal hairs, has these hairs much longer and their dark tips more developed, and the fur generally is finer and softer. The skull, with a general similarity of outline, exhibits numerous differences, the most marked being the very much smaller proportional size of the molars in the upper jaw. The crown of the third molar is *A. Himalayanus* measures 6 mm. across, in *A. bobac* only 4·5 mm.

I am also indebted to Dr. Günther for having very obligingly re-examined the types of *Arctomys Hemachalanus* v. *Tibetanus* in the British Museum in order to ascertain if they were adults. He writes to me as follows :

"The skull of the type of *A. Tibetanus* is that of an adult animal, but "this type is the most wretched specimen I have ever handled. It was an "individual brought up in captivity ; size that of a very small rabbit, skin "nearly hairless, claws abnormally long and as sharp as a needle, teeth "carious, incisors malformed. The frontal bones are gone, but I suppose "that they could not have been much arched, and the palate is very shallow, "very slightly concave."

"There is another flat and imperfect skin of this *A. Tibetanus* from "Hodgson's collection. It is somewhat larger than the former specimen, "and is evidently adult, but there is no skull. Taking all the evidence "before me, I believe that this species but slightly exceeded a rabbit in "size. But then what differences in size you observe in our Swiss mar-"mots."

The important point is, of course, to ascertain that Mr. Hodgson's original types were adult. The length of the tail shews that the species is distinct from *A. caudatus*, and the skulls differ very considerably. But some further evidence is forthcoming. Some time after the preceding paper was written the dead body of a marmot was sent to the Indian Museum by Mr. Rutledge. The animal is said to have been originally brought from Bhútán, but it has lived for a long time in captivity, and as usual the skin is in wretched condition and almost hairless. The dimensions, however, agree with those of *A. Hemachalanus*, and when the skull had been cleaned, it proved precisely similar to that of the old skeleton in the Museum, belonging to the animal said to have brought from Sikkim and to have lived for months in the Asiatic Society's compound. Mr. Fraser has also found, amongst the accumulated collections of the Museum, another skin and skull of a young individual, which also had been kept tame.

There is thus evidence of 5 individuals of this species at least, and I

have examined 3 skins and skulls myself. With the evidence before me, I have not the slightest doubt that a small marmot does inhabit the northern parts of Sikkim and Nepal, and that it is quite distinct in structure, colour, and size from the large *A. caudatus* of Kashmir and Ladak. Unfortunately, the Sikkim skins which Dr. Anderson identified with a specimen belonging to the Kashmir species have not been found. It is remarkable that every individual of *A. Hemachalanus* yet examined has been kept in captivity; skins of the wild animal are a great desideratum. The skull of the specimen received from Mr. Rutledge is perfectly well formed and all the teeth are healthy.

Dr. Aitcheson of Srinagar has had the kindness to make enquiries about the marmots of Kashmir, and he has sent me specimens of young *A. caudatus*. As in most young animals, the colours are indistinct, and there is a peculiar immature appearance about the fur. These young specimens can be at once distinguished from *A. Hemachalanus* by their longer tails.

It will be seen that the whole of the additional evidence tends to prove that, exclusive of *A. robustus*, there are three and not two species of marmot in the Himalayas and Tibet, and that neither of these species is identical with *A. bobac*.

Within the last few days, Mr. Mandelli of Darjiling has sent to the Indian Museum a magnificent collection of mammal skins from Sikkim and Tibet, part of which he has presented to the Museum, and he has most liberally allowed me to examine the whole. There is no specimen of *Arctomys Hemachalanus*, but there are two fine skins of *A. Himalayanus*. These coincide very fairly in external characters with those from the Kuenluen, they are a very little greyer in tint and darker on the face, but there can be no hesitation in referring both forms to the same species. The skull of one of Mr. Mandelli's skins has been extracted for me by Mr. Fraser. Although it is near to that of the Kuenluen marmot and to that of *A. robustus*, it differs somewhat from both; its longitudinal and transverse diameters being 101 and 67 millemeters, so that it is decidedly broader in proportion to its length, whilst its height is rather less, and the nasal bones are shorter and less convex. Despite these and other differences, there is a general agreement in details, and I feel disposed to believe that the distinctions are insufficient for separation. Moreover, it is evident that the cranial distinctions already pointed out in the case of *A. robustus* are not greater than those which are found between the two forms of *A. Himalayanus*, and, consequently, that either *A. robustus* must be united to that species, or the Kuenluen marmot must be classed as distinct. I prefer the former view and have adopted it in the preceding synonymy.

Dr. Severtzoff has recently visited London, and I am indebted to Mr. Dresser for obtaining from the Russian naturalist a few notes on some of the

mammals described by him from Western Turkestan. I learn that the species identified as *Arctomys baibacinus* differs from *A. bobac* in being darker above, and more rufous below. It is a mountain species, whilst *A. bobac* inhabits the steppes. Dr. Severtzoff suggests that it may be identical with *A. robustus* (that is, doubtless, with *A. Himalayanus*). As *A. Himalayanus* extends from Eastern Tibet to the Kuenluen, keeping to great altitudes, above the range of almost every other mammal, it is by no means improbable that it may also occur farther to the north.

P. S.—*Nov.* 8*th.*—In the October number of the 'Annals and Magazine of Natural History' just received, Dr. Anderson has described another marmot from the mountains north of Kábul under the name of *A. dichrous.* From the description this appears to be distinct from *A. aureus* and the other species referred to above, and it is very probably the form indicated by Burnes and Griffith, a skull of which, as already mentioned, exists in the Society's old collection.

XIV.—*Contributions towards a Knowledge of the Burmese Flora.* *Part* II.—*By* S. Kurz.

(Continued from Vol. XLIII, p. 141.)

RUTACEÆ.

Conspectus of genera.

A. Fruit separating into 2 to 5 distinct 2-valved carpels.

Trib. I. ZANTHOXYLEÆ. Flowers usually polygamous. Disk free, or rarely wanting. Styles basilar or ventral, more or less free. Fruit-carpels coriaceous, the endocarp persistent or separating elastically.

× Leaves opposite or nearly so, rarely intermixed with nearly alternate ones. Unarmed.

Evodia. Stamens 4-5. Leaves often compound, rarely 1-foliolate.

Melicope. Stamens 8. Leaves often 1- rarely 3-foliolate.

× × Leaves all alternate. Often armed.

Zanthoxylon. Petals 3—5, rarely none. Stamens as many. Leaves often pinnate.

B. Fruit a drupe or berry, rarely a capsule.

Trib. II. TODDALIEÆ. Flowers usually polygamous. Disk free. Style single. Albumen usually present.

Acronychia. Petals 4. Stamens 8. Drupe or capsule 4-celled. Erect unarmed trees with 1—3-foliolate leaves.

Toddalia. Petals 2—5. Stamens as many. Berry 4—7-celled. Climbers, often armed, with usually 3-foliolate leaves.

Trib. III. AURANTIEÆ. Flowers hermaphrodite. Petals and stamens free or connate. Style simple. Ovules 1, 2 or more in each cell. Berry often pulpy, with a coriaceous or woody rind. Albumen none.

× *Ovary-cells with* 1 *or* 2 *ovules only.*

+ Style persistent, not jointed at the base.

Glycosmis. Calyx 5-parted or -toothed. Stamens 10, free. Ovules solitary. Leaves pinnately 5-1—or rarely 7-foliolate.

+ + Style jointed at the base, deciduous.

† Leaves pinnate or 3-foliolate.

* Ovules 2 in each cell.

O Leaves pinnate or pinnately 3-foliolate.

‡ Cotyledons plano-convex, fleshy. Petals imbricate.

Chalcas. Filaments linear-subulate. Unarmed, the flowers in terminal cymes.

Clausena. Filaments dilated at the base. Unarmed, the flowers in panicles or racemes.

‡ ‡ Cotyledons crumpled, leafy. Petals valvate.

Micromelum. Filaments linear-subulate. Unarmed, the flowers in terminal corymbs.

O O Leaves digitately 3-foliolate.

Luvunga. Calyx cup-shaped. Stamens 8 or 10. Armed or not.

* * Ovules solitary in each cell.

TRIPHASIA. Calyx 3-lobed. Stamens 6. Spiny; leaves digitately 3-foliolate; flowers almost solitary.

LIMONIA. Calyx 4- or 5-lobed or -parted. Stamens 8—10. Armed; leaves pinnate.

† † Leaves 1-foliolate or simple.

PARAMIGNYA. Anthers linear-oblong. Disk elongate. Calyx usually cup-shaped. Climbers, armed. Berries without pulp.

ATALANTIA. Anthers ovate or cordate. Disk cup-shaped. Calyx often irregular. Trees or shrubs, often armed. Berries with vesicular pulp.

× × *Ovary-cells with numerous ovules.*

† Rind of berry leathery. Leaves 1-foliolate.

CITRUS. Stamens 20—60, often connate. Trees, usually spiny.

† † Rind of berry woody. Leaves compound. Trees.

FERONIA. Ovary 5—6-celled. Leaves pinnate.

AEGLE. Ovary 8- to many-celled. Leaves trifoliolate.

Evodia, Forst.

Conspectus of species.

× Panicles small, contracted, usually much shorter than the petioles.

Branchlets 4-cornered and marked with 4 prominent longitudinal lines; leaves 1—3-foliolate, the leaflets sessile; stamens shorter than the petals, ... *E. viticina.*

Branchlets quite terete; leaves 8-foliolate, the leaflets on short petiolules, lively green, .. *E. triphylla.*

× × Panicles corymbose, spreading, as long or longer than the petiole.

Branchlets terete, thick; leaflets shortly petioluled, dark bluish-green, *E. Roxburghiana.*

1. E. VITICINA, Wall. Cat. 1219; Hf. Ind. Fl. I. 489.

HAB. Tenasserim, Tavoy.

2. E. TRIPHYLLA, DC. Prod. I. 724; Hf. Ind. Fl. I. 488.

HAB. Frequent in the damp hill-forests, and entering the drier ones, from Martaban down to Tenasserim, at 3000 to 5000 ft. elevation.—Fl. Febr., March; Fr. Apr., May.

3. E. ROXBURGHIANA,* Bth. Fl. Hongk. 59; Hf. Ind. Fl. I. 487.—(*Xanthoxylon triphyllum*, Wight Jc. t. 204; *Fagara triphylla*, Roxb. Fl. Ind. I. 416).

HAB. Tenasserim.

Roxburgh's figure of the fruit in his MS. drawings shews that the size of the carpels and seeds does not differ from that of the plant formerly usually taken for *E. triphylla.*

Melicope, Forst.

1. M.? HELFERI, Hf. Ind. Fl. I. 492.

HAB. Tenasserim (or Andamans?) (*teste* Hf.).

Zanthoxylum, L.

Conspectus of species.

* *Cymes axillary, or axillary and terminal. Branches alternate. Leaves pinnate.*

× Rachis of leaves winged. Flowers apetalous.

Leaflets 2—3 in. long, glandular-crenulate; cymes dense, ½—1 in. long; fruit-carpels usually by 4—2, ... *Z. acanthopodium.*

Leaflets coarsely crenate, ½—1 in. long, ... *Z. Andamanicum.*

× × Rachis of leaves not winged. Flowers 4—5-petalous.

Leaflets in 2—3 pairs, glossy on both sides; cymes axillary,........ *Z. Hamiltonianum.*

* * *Cymes terminal. Branches opposite.*

Leaflets glandular-crenate, in 7—10 pairs,................................ *Z. Budrunga.*

1. Z. ACANTHOPODIUM, DC. Prod. II. 727; Hf. Ind. Fl. I. 493.

HAB. Ava, hills east of Bhamo.

2. Z. ANDAMANICUM, Kurz MS.

HAB. In the tropical forests of Termoklee island, west of South Andaman.

A very distinct small-leaved species, but the flowers and fruits are unknown.

3. Z. HAMILTONIANUM, Wall. Cat. 7117; Hf. Ind. Fl. I. 494.

HAB. Burma (*teste* Hf.).

4. Z. BUDRUNGA, DC. Prod. I. 728; Hf. Ind. Fl. I. 495. (*Fagara Budrunga*, Roxb. Fl. Ind. I. 447).

HAB. Not unfrequent in the tropical and moister upper mixed forests from Chittagong, Pegu, and Martaban down to Tenasserim.—Fr. Sept.

Doubtful species.

1. *Z. spondiæfolium*, Wall. Cat. 1217; Hf. Ind. Fl. I. 496.

HAB. Amherst (Wall.) *teste* Hf.

Acronychia, Forst.

1. A. CYMINOSMA, F. Muell. Fragm. Phyt. Amstr. I. 27. (*A. laurifolia*, Bl. Bydr. 245; Hf. Ind. Fl. I. 498; *Cyminosma pedunculata*, DC. Prod. I. 722; Wight Ill. t. 65).

HAB. Not unfrequent in the tropical forests of the Andamans; also Pegu and Chittagong.—Fl. RS.

Toddalia, Juss.

1. T. ASIATICA, (*Paullinia Asiatica*, L. sp. pl. 524; *T. aculeata*, Pers. Ench. I. 249; Hf. Ind. Fl. I. 497 (excl. syn. *Zanthox. nitidum*, Wall.) Wight Ill. t. 66; *Scopolia aculeata*, Sm. Icon. ined. sub. t. 34; Roxb. Fl. Ind. I. 616).

VAR. *α.* ACULEATA, (*T. aculeata*, Pers.), petioles and often also the midrib beneath hooked-prickly; panicles usually smaller and less branched.

VAR. *β.* FLORIBUNDA, (*T. floribunda*, Wall. Pl. As. rar. III. 17. t. 232), petioles and midrib of leaves unarmed; panicles often more compound.

HAB. Frequent in the tropical forests from Ava and Martaban down to Pegu, up to 3000 ft. elevation.—Fl. June.

N. B.—It is possible that in Wallich's Herbarium *Toddalia* and *Zanthoxylon nitidum*, DC., are mixed, but the Wallichian specimens in HBC., as well as those cultivated in this garden, all belong to DeCandolle's species.

Glycosmis, Correa.

Conspectus of species.

* *Anthers blunt, not gland-tipped.*

O Berries oboval-oblong to oblong, leaden blue.

Petals longer persistent; filaments flat, from a narrower base gradually broader towards the triangular apex; bark pale coloured, ... *G. cyanocarpa.*

O O Berries more or less globular, from watery flesh-coloured to crimson.

Petals very deciduous; filaments from a broader base attenuated upwards; nerves of leaflets prominent above; bark pale coloured, ... *G. trifoliata.*

Petals very deciduous, lanceolate, about 3 lin. long; filaments elongate, filiform; bark brown, ... *G. arborea.*

* * *Anthers gland-tipped.*

Petals longer persistent, about $1\frac{1}{2}$ lin. long; anthers cordate; filaments flat, from a narrower base gradually broader towards the triangular apex; bark white, .. *G. pentaphylla.*

1. G. CYANOCARPA, Spreng. Syst. Veg. IV/2. 161; Miq. Fl. Ind. Bat. I/2. 521.—(*Cookia cyanocarpa*, Bl. Bydr. 136).

VAR. *α.* GENUINA, flowers in peduncled terminal and axillary panicles, rarely reduced to cymes.

VAR. *β.* CYMOSA, (*G. tetraphylla*, Wall. and *G. oxyphylla*, Wall. ap. Voigt. Cat. Hort Calc. 139), flowers in short peduncled or almost sessile quite glabrous or rarely rusty tomentose cymes axillary or axillary and terminal, rarely transformed into panicles.

HAB. Var. *β.* Not unfrequent in the tropical forests of the Pegu Yomah.—Fl. Apr.

2. G. TRIFOLIATA, Spreng. Syst. Veg. IV/2 162; Miq. Fl. Ind. Bat. I/2. 521.

VAR. *α.* GENUINA, leaves green or yellowish in drying; panicles or cymes shorter, more or less rusty or tawny tomentose; ovary glabrous or tawny pubescent.

VAR.? *β.* FUSCESCENS, leaves fuscescent in drying; panicles larger and more compound, quite glabrous.

HAB. Var. *α.* In Chittagong and Tenasserim; var. *β.* frequent in the tropical forests all over Burmah from Chittagong, Pegu, and Martaban down to Tenasserim and the Andamans.—Fl. HS.; Fr. RS.

All the specimens of var. *β.* are in young bud only, and therefore the identification with *G. trifoliata* is doubtful. Those of var. *α.* are in young bud only and also doubtful; they can equally well belong to *G. insularis.*

3. G. ARBOREA, Corr. in Ann. Mus. VI. 386.; DC. Prod. I. 538. (*Limonia arborea*, Roxb. Corom. Pl. I. t. 85. and Fl. Ind. II. 381).

VAR. α. GENUINA, calyx-lobes acute; ovary sessile; leaves often serrate; panicles peduncled.

VAR. β. INSULARIS, calyx-lobes bluntish; ovary usually stalked; leaves entire; cymes small, sessile, rusty-villous.

HAB. Var. β. Common in the tropical forests of the Andamans.—Fl. Febr.; Fr. Apr. May.

4. G. PENTAPHYLLA, Corr. in Ann. Mus. VI. 386; DC. Prod. I. 538; WA. Prod. I. 93; Bedd. Fl. Sylv. Madr, Anal. 43. t. 6. f. 6. (*Limonia pentaphylla*, Retz. Obs. V. 24; Roxb. Corom. Pl. t. 84. and Fl. Ind. II. 381; *Limonia arborea*, Bot. Mag. t. 2074).

HAB. Frequent all over Burmah, in the mixed and tropical forests, and more especially in the shade of village-bushes and bamboo-jungles.—Fl. CS.; Fr. HS.

Chalcas, L. (1767) (**Murraya,** L. 1771).

Conspectus of species.

Leaflets 3 to 8; petals nearly ½ in. long, ... *C. paniculata.*
Leaflets 10 to 20; petals about 2 lin. long, ... *C. Kœnigii.*

1. C. PANICULATA, L. Mant. 1261; F. Muell. in Contr. New Hebrid. 7.—(*Murraya exotica*, L. Mant. 563; Hf. Ind. Fl. I. 502).

HAB. Common in the tropical forests of the Pegu Yomah and Martaban down to Tenasserim and the Andamans.—Fl. HS.; Fr. May, June.

2. C. KŒNIGII, (*Murraya Kœnigii*, Spreng. Syst. veg. II. 315; Hf. Ind. Fl. I. 503.—(*Bergera Kœnigii*, L. Mant. 563; Roxb. Corom. Pl. II. t. 112. and Fl. Ind. II. 375; Wight Icon. t. 13; Griff. Not. Dicot. 497. t. 586. f. 3; *Murraya fœtidissima*, T. et B. in Tydsch. Ned. Ind. XXV. 25).

HAB. Rather frequent along choungs in the tropical forests of the eastern slopes of the Pegu Yomah; also Chittagong.—Fl. March.

Doubtful species.

1. *Murraya elongata*, DC. ap. Hf. Ind. Fl. I. 503.

HAB. Ava, Taong-dong (Wall.).

Clausena, Burm.

Conspectus of species.

* *Panicle terminal.*

O Ovary glabrous.

Softly villous; leaves pinnately 5-foliolate; flowers 4-merous, ... *C. macrophylla.*
Inflorescence and leaves glabrous; petiole and rachis terete or nearly so; leaflets usually 7 (5—9), not or hardly oblique; flowers usually 4- rarely 5-merous, *C. heptaphylla.*
Inflorescence and leaves glabrous; rachis more or less winged; leaflets 13—17, oblique; flowers 5-merous, ... *C. Wallichii.*

O O Ovary more or less hirsute or pubescent.

Inflorescence and other parts more or less shortly hirsute or puberulous; rachis terete;

leaflets 15—30, oblique; flowers 5-merous, ... *C. excavata.*

Inflorescence and the tubercled petioles densely and shortly tawny tomentose; leaflets 5—9; young berries densely fascicled-tomentose; flowers 5-merous, ... *C. Wampi.*

* * *Panicles or racemes axillary.*

All parts shortly pilose; leaflets 5 to 17; ovary and the long red berries glabrous; flowers 4-merous, ... *C. suffruticosa.*

1. C. MACROPHYLLA, Hf. Ind. Fl. I. 504.

HAB. Upper Tenasserim, banks of Salween at Trogla.

2. C. HEPTAPHYLLA, WA. Prod. I. 95; Hf. Ind. Fl. I. 504.—(*Amyris heptaphylla*, Roxb. Fl. Ind. II. 248).

HAB. Chittagong; Tenasserim (*teste* Hf.).

3. C. WALLICHII, Oliv. in Journ. Linn. Soc. V. Suppl. II. 35; Hf. Ind. Fl. 505.—(*Cookiæ sp.*, Griff. Not. Dicot. 469. t. 587. f. 2 ?). VAR. *β*. LUXURIANS, rachis leafy-winged; leaflets only in 4—2 pairs with an odd one, 4—8 in. long, remaining green in a dried state.

HAB. Var. *α*. Upper Tenasserim; var. *β*. rare in the tropical forests of the eastern slopes of the Pegu Yomah. Fl. March.; Fr. Apr.

4. C. EXCAVATA, Burm. Fl. Ind. 87; Hf. Ind. Fl. I. 504.—(*Amyris Sumatrana*, Roxb. Fl. Ind. II. 250; *Amyris punctata*, Roxb. l. c. 251.)

HAB. Frequent in the tropical and moister upper mixed forests, all over Burmah and the adjacent provinces, from the plains up to 2000 ft. elevation. Fl. Apr. May; Fr. June, Jul.

*5. C. WAMPI, Blanco Fl. Filip. 358; Hf. Ind. Fl. I. 505.—(*Cookia punctata*, Sonner. Voy. II. 130. t. 131; Roxb. Fl. Ind. II. 382).

HAB. Cultivated in Chittagong.

6. C. SUFFRUTICOSA, WA. Prod. I. 96. in adn.; Hf. Ind. Fl. I. 506.—(*Amyris saffruticosa*, Roxb. Fl. Ind. II. 250).

VAR. *β*. PAUCIJUGA, leaflets only in 2 to 3 pairs with an odd one.

HAB. Chittagong, Seetakhoond hills; var. *β*. not unfrequent in the Eng- and dry forests of the Prome district.—Fl. March.

Micromelum, Bl.

Conspectus of the species.

Tree; petals 2½ lin. long; ovary slightly appressed-pubescent; young berries stalked glabrous, ... *M. pubescens.*

Meagre shrub up to 4 ft. high; petals 2 lin. long; ovary densely tawny hirsute; young berries sessile or nearly so, puberulous, ... *M. hirsutum.*

I. M. PUBESCENS, Bl. Bydr. 138; Hf. Ind. Fl. I. 501.—(*Bergera integerrima*, Roxb. Fl. Ind. III. 376.)

VAR. *α*. GENUINA, leaves on both sides or at least along the nerves beneath, the petioles, and rachis puberulous.

VAR. *β*. GLABRIUSCULA, leaves quite glabrous.

HAB. Both varieties frequent in the tropical and moister upper mixed

forests all over Burma from Chittagong and Ava down to Tenasserim and the Andamans.—Fl. Jan. March; Fr. Apr. June.

2. M. HIRSUTUM, Oliv. in Linn. Proc. V. Suppl. II. 41; Hf. Ind. Fl. I. 502.—(*M. Zeylanicum*, Wight in Thw. C. P. 188).

VAR. α. GENUINUM, all parts more or less shortly hirsute or puberulous; leaflets smaller.

VAR. β. GLABRESCENS, (*Aurantiacea*, Wall. Cat. 8517.) the young shoots only tawny puberulous, all other parts glabrous or nearly so; calyx shortly 5-toothed, puberulous; petals puberulous.

HAB. Var. α. Very frequent in the open and dry forests, especially in the Eng-forests, all over Burma from Ava and Martaban down to Tenasserim; var. β. in Tenasserim from Moulmein southwards (Helf. 535/1).—Fl. March, Apr.

Luvunga, Ham.

Conspectus of species.

Filaments glabrous, more or less connate, ... *L. scandens.*
Filaments glabrous, free; flowers much smaller, ... *L. eleutherandra.*

1. L. SCANDENS, Ham. ap. Oliv. in Linn. Proc. V. Suppl. II. 43; Hf. Ind. Fl. I. 509; Bot. Mag. t. 4522.—*Limonia scandens*, Roxb. Fl. Ind. II. 380).

HAB. Burma (Ava?); Chittagong.

2. L. ELEUTHERANDRA, Dalz. in Hook. Kew. Journ. Bot. II. 258; Hf. Ind. Fl. I. 509, excl. syn. Bl.—(*Luvunga Tavoyana*, Wall. Cat. 6383).

HAB. Tenasserim, ? Tavoy, (*teste* Hf.)

Triphasia, Lour.

1. T. TRIFOLIATA, DC. Prod. I. 536; Hf. Ind. Fl. I. 507.

HAB. Tennasserim, probably wild.—Fl. Fr. ∞.

Limonia, L.

Conspectus of species.

Spiny tree; leaflets opposite; inflorescence puberulous; berries globose, sessile .. *L. acidissima.*

Unarmed shrub; leaflets alternate; inflorescence glabrous; berries ovoid, shortly stalked, ... *L. alternans.*

1. L. ACIDISSIMA, L. sp. pl. 554; Hf. Ind. Fl. I. 507.—(*L. crenulata*, Roxb. Corom. Pl. I. t. 86. and Fl. Ind. II. 381).

VAR. β. PUBESCENS (*L. ? pubescens*, Wall. Cat. 6365; Hf. Ind. Fl. I. 507), prickles on the branches short, the wings of the petiole narrow, leaflets bluntish, the terminal one long but bluntish acuminate, the petioles and nerves beneath softly puberulous.

HAB. Var. *a.* Ava, along the Irrawaddi, apparently frequent; var. *β.* Ava, Taong dong; and Prome hills.

2. L. ALTERNANS, Wall. ap. Voigt. Hort. Calc. 139; Hf. Ind. Fl. I. 508.

HAB. Not unfrequent in the upper-mixed, and sometimes in the moist, forests of the Pegu Yomah and Arracan; also Tenasserim, Mergui.—Fl. May.

Paramignya, Wight.

Conspectus of species.

* Petals about 8 lin. long. Calyx largish, cupular, broadly lobed.

Style elongate; calyx and pedicels tomentose, the latter as long or a little longer than the calyx, ...*P. monophylla.*

Style short; calyx and the pedicels glabrous, the latter 1 in. or thereabouts long, ..*P. grandiflora.*

* * Petals 2—4 lin. long. Calyx small, with acute lobes.

O Berries terete.

Young shoots more or less puberulous; style short, hirsute or villous,..*P. Griffithii.*

Glabrous; style very short, like the ovary glabrous, ...*P. citrifolia.*

O O Berries 3—4-angular.

Erect tree, the spines 1—1½ in. long, straight; calyx glabrous, ...*P. angulata.*

1. P. MONOPHYLLA, Wight Ill. I. 108. t. 42; Hf. Ind. Fl. I. 510.—

HAB. Tenasserim, Moulmein district at 5000 feet elevation (*teste* Oliv.).

2. P. GRANDIFLORA, Oliv. in Linn. Proc. V. Suppl. II. 42; Hf. Ind. Fl. I. 510.

HAB. Tenasserim, Tavoy.—Fl. Aug.

3. P. GRIFFITHII, Hf. Ind. Fl. I. 510.—(*Citrus scandens,* Geoff. Not. Dicot. 495, t. 587. f. 1).

HAB. Ava, at the serpentine mines of Hookhum valley; Pegu (*teste* Hf.).

4. P. CITRIFOLIA, Hf. Ind. Fl. I. 510, non Oliv.—(*Limonia citrifolia,* Roxb. Fl. Ind. II. 579.; *P. micrantha,* Kurz in And. Rep. App. B. 4).

HAB. In the tropical forests of Chittagong and the Andamans.—Fl. June, July.

5. P. ANGULATA (*Citrus angulatus,* Willd. sp. pl. III. 1426; DC. Prod. I. 540; *Limonellus angulosus,* Rumph. Herb. Amb. 110. t. 32; *Limonia angulosa,* WA. Prod. I. 91, in adn.; Miq. Fl. Ind. Bat. I. 2-521; *Atalantia longispina,* Kurz in Journ. As. Soc. Beng. 1872. 295; *Paramignya longispina,* Hf. Ind. Fl. I. 511; *Gonocitrus angulatus,* Kurz in Journ. As. Soc. Beng, 1873. 228. t. 18).

HAB. In the mangrove and tidal forests of Pegu and Tenasserim (also Sunderbuns, Malacca, and the Moluccos).

N. B.—This species has got quite an array of synonyms. I attempted to establish a new genus upon it on account of the angular fruits and absence of pulp, but on examining the fruits of several other *Paramignyas*, I find that they also seem to be pulpless.* *Atalantia missionis*, Oliv. (Hf. Ind. Fl. I. 513, excl. syn. Turcz.) has curiously enough retained its place in *Atalantia*, although habit and generic characters place its beyond any doubt in *Paramignya*, and in habit it approaches very much the above species.

Atalantia, Corr.

Conspectus of species.

× Calyx irregularly lobed, split to the base on one side.

Berries the size of a large pea or small cherry, ... *A. monophylla.*

Berries the size of a wood-apple, ... *A. macrophylla.*

× × Calyx regularly 4-lobed.

Flowers shortly pedicelled, in short racemes, ... *A. caudata.*

1. A. MONOPHYLLA, Corr. in Ann. du Mus. VI. 383; Hf. Ind. Fl. I. 511.—(*A floribunda*, Wight. Icon. t. 1611.; *Limonia monophylla*, Lin. Mant. alt. 237; Roxb. Fl. Ind. II. 378 and Corom. Pl. I. t. 82; *A. puberula*, Miq Ann. Mus. Lugd. Bat. I. 211; *Chilocalyx ellipticus*, Turcz. in Bull. Natur. Mosc. 1863, 588).

HAB. Ava, about Segain, very frequent.—Fl. Octob.

2. A. MACROPHYLLA (*A monophylla* var. *macrophylla*, Oliv. in Linn. Proc. V. Suppl. II. 24; Hf. Ind. Fl. I. 512).

HAB. Frequent along the beaches of the Andaman islands; also Tenasserim.—Fr. Apr. May.

3. A. CAUDATA, Hf. Ind. Fl. I. 513?—

HAB. Frequent in the tropical forests of the Pegu Yomah, especially along choungs.

The Burmese plant is a middling-sized tree of elegant appearance but spiny. I have not met either with flowers or fruits and therefore the identification must remain doubtful.

Citrus, L.

Conspectus of species.

× Young shoots and nerves of leaves beneath pubescent or puberulous; flowers and fruits large, ... *C. decumana.*

× × All parts glabrous.

O Style very short.

Flowers small; stamens free; petioles leafy and almost as long and as broad as the blade itself, ... *C. hystrix.*

O O Style as long as the ovary or much longer.

† Petals 8 to 10 lin. long.

* The berries of *P. littoralis*, Miq., a species nearly allied to *P. angulata*, has pulp, but the dried ones appear pulpless.

Leaves acuminate or acute, the petiole often winged; berries globular, without a knob; filaments cohering by 3—4, ... *C. Aurantium.*

Leaves blunt or nearly so, the petiole not winged; berries oblong to globose, with a knob, the skin usually thick; filaments free or polyadelphous, ... *C. medica.*

† † Petals 3—4 lin. long.

Calyx small; berries globular, sweet or acid, the skin usually thin, ... *C. nobilis.*

*1. C. DECUMANA, L. sp. pl. 1100; Roxb. Fl. Ind. III. 393; Hf. Ind. Fl. I. 516.

HAB. Often cultivated by Burmans, especially in the southern provinces.

2. C. HYSTRIX, DC. Prod. I. 539; Hf. Ind. Fl. I. 515.

HAB. Not unfrequent in the tropical forests of the Martaban hills; also in the adjoining Siamese province Kyouk-Koung; often cultivated in native gardens.

*3. C. AURANTIUM, L. sp. pl. 1100; Hf. Ind. Fl. I. 515.

HAB. Here and there cultivated in villages.

4. C. MEDICA, L. sp. pl. 580; Roxb. Fl. Ind. III. 392; Hf. Ind. Fl. I. 514. exl. var. 4.

VAR. α. GENUINA, Brandis Forest. Fl. 52.; Hf. l. c.

VAR. β. LIMONUM, Brand. For. Fl. 52.

VAR. γ. ACIDA, Brand. For. Fl. 52; Hf. l. c.—(*C. acida,* Roxb. Fl. Ind. III. 390).

HAB. Var. γ. apparently wild in the Khaboung forests of the Pegu Yomah, west of Tounghoo (Brandis); the other varieties only cultivated.

*5. C. NOBILIS, Lour. Fl. Cochin. 569; DC. Prodr. I. 540.; Ker Bot. Rep. t. 211; Andr. Bot. Rep. t. 608 (*Aurantium Sinense,* Rumph. Herb. Amb. II. t. 34; *C. medica* var. 4 *limetta,* Brandis For. Fl. 52; Hf. Ind. Fl. I. 515).

VAR. α. SINENSE, (*Aurantium Sinense,* Rph. l. c.), petioles simple; berries with a sweet or bitter pulp. Sweet lime.

VAR. β. LIMONELLUS, (*Limonellus,* Rumph. l. c. t. 29; *C. limetta,* Wight Ic. t. 958), petioles short, winged; fruits acid. Acid lime.

HAB. Frequently cultivated in villages.

Feronia, Corr.

1. F. ELEPHANTUM, Corr. Act. Soc. Linn. V. 224; Roxb. Corom. Pl. II. t. 141. and Fl. Ind. II. 411; Wight Icon. t. 15.; Hf. Ind. Fl. I. 516.

HAB. In the dry forests of Prome District.—Fl. March, Apr.; Fr. Octob.

Aegle, Corr.

1. A. Marmelos, Corr. Act. Soc. Linn. V. 224; Roxb. Corom. Pl. II. t. 143 and Fl. Ind. II. 579; Wight Icon. t. 16; Hf. Ind. Fl. I. 516; Bedd. Fl. Sylv. t. 161.

Hab. Much cultivated, especially in the Prome district, and said to occur wild in the forests also: I found the tree in those of the Toukyeghat, east of Tounghoo.—Fl. May; Fr. Octob. Nov.

SIMARUBEÆ.

Conspectus of genera.

Trib. I. SIMARUBEÆ. Ovary deeply lobed or the carpels distinct.

* Stamens twice as many as petals.

O Leaves simple.

Samadera. Calyx 3—5-parted. Disk large. Stamens 8—10. Drupe variously winged.

O O Leaves pinnate.

Ailanthus. Calyx 5- cleft. Disk 10-lobed. Stamens 10. Fruit of 1 to 5 samaras.

* * Stamens as many as petals. Leaves pinnate. Carpels drupaceous.

O Styles free or cohering at the base only.

Brucea. Disk 4-lobed. Stamens glabrous. Flowers cymose-racemose.

O O Styles connate. Flowers in panicles.

Picrasma. Disk thick. Stamens pilose.

Eurycoma. Disk none. Stamens glabrous.

Trib. II. PICRAMNIEÆ. Ovary entire, 2—5-celled.

Harrisonia. Calyx 4—5-cleft. Stamens 4 or 10. Ovary 4—5-celled. Leaves pinnate, or pinnately 1—3-folialate.

Balanites. Sepals 5. Stamens 10. Ovary 5-celled. Leaves bifoliolate.

Samadera, Gærtn.

1. S. Indica, Gærtn. Fruct. II. t. 156. fig. inf.; Wight Ill. t. 68; Hook. Icon. Pl. t. 7; Hf. Ind. Fl. I. 519.

Var. *α.* genuina, peduncles about as long as the leaves; drupes about $2\frac{1}{2}$ in. long, smooth or slightly net-veined; filaments in bud erect.

Var. *β.* lucida, (*Niota lucida,* Wall. Pl. As. rar. II. t. 168; *Samadera lucida,* Benn. in Hf. Ind. Fl. I. 519; *S. brevipetala,* Scheff. Obs. phyt. 88), peduncles shorter than the leaves; drupes $1\frac{1}{2}$—2 in. long, strongly net-veined; filaments in bud twisted.

Hab. Var. *β.* Upper Tenasserim, Moulmein.

Ailanthus, Desf.

1. A. Malabaricus, DC. Prod. II. 89; Wight Icon. t. 1604; Bedd. Fl. Sylv. t. 122; Hf. Ind. Fl. I. 518.

Hab. Rather rare in the tropical forests of the Khaboung valley, eastern slopes of Pegu Yomah. Fr. Apr.

Brucea, Mill.

Conspectus of species.

Leaflets coarsely crenate-toothed; drupes about 2 lin. long, ... *B. Sumatrana.*
Leaflets quite entire; drupes about 3—4 lin. long, ... *B. mollis.*

1. B. SUMATRANA, Roxb. Fl. Ind. I. 449; Hf. Ind. Fl. I. 521.

HAB. Tenasserim, Mergui (Griff.)

2. B. MOLLIS, Wall. Cat. 8483; Hf. Ind. Fl. I. 521.

HAB. In the drier and damp hill-forests of Martaban and Upper Tenasserim, at 3000 to 4000 ft. elevation.—Fl. March.

Picrasma, Bl.

1. P. JAVANICA, Bl. Bydr. 248; Benn. in Horsf. Pl. Jav. rar. 197. t. 41; Miq. Fl. Ind. Bat. I/2. 679. t. 28; Hf. Ind. Fl. I. 520.—(*P. Andamanica,* Kurz And. Rep. App. B. IV; Hf. Ind. Fl. I. 520).

HAB. Frequent in the tropical forests from Martaban down to Tenasserim and the Andaman islands; rare in those of the Pegu Yomah.—Fl. March; Fr. Begin of R. S.

Eurycoma, Jack.

1. E. LONGIFOLIA, Jack in Roxb. Fl. Ind. ed. 1. II. 307; Griff. Not. Dicot. 435; Hf. Ind. Fl. I. 521.—(*E. Merguensis,* Planch. in Hook. Lond. Journ. V. 583).

HAB. Forests of Tenasserim from Tavoy southwards; Andamans (*teste* Bennet).

Harrisonia, R. Br.

I. H. BENNETII, Bth. and Hf. Gen. pl. I. 314; Hf. Ind. Fl. I. 519. —(*Lasiolepis paucijuga,* Benn. in Horsf. Pl. Jav. rar. 202. t. 42).

HAB. Very frequent in the dry forests of the Prome district; also in Martaban, Yoonzeleen, 2000 ft. (Brandis).—Fl. Apr.

Balanites, Del.

1. B. ROXBURGHII, Planch. in Ann. sc. nat. 4 ser. II. 258; Hf. Ind. Fl. I. 522.—(*Ximenia Aegyptiaca,* Roxb. Fl. Ind. II. 253; *B. Aegyptiaca,* Wight Icon. t. 274, non Del.).

VAR. β. GRACILIS, branchlets slender and glabrous or nearly so; inflorescence more glabrous than in the normal form and only puberulous, the peduncles and pedicels all very slender.

HAB. Ava; var. β. in the Prome District.—Fl. Apr.

OCHNACEÆ.

Conspectus of genera.

Trib. I. OCHNEÆ. Ovary 2—10-celled, with a solitary ovule in each cell. Albumen none.

OCHNA. Stamens indefinite. Drupes 3 to 10, seated on the enlarged torus. Corymbs lateral.

GOMPHIA. Stamens 10. Drupes 3—5, seated on the enlarged torus. Panicles terminal.

TETRAMERISTA. Flowers 4-merous. Stamens 4. Fruit a coriaceous 4-seeded berry.

Trib. II. EUTHEMIDEÆ. Ovary half 5-celled, with 2 ovules in each cell. Seeds with albumen.

EUTHMIS. Stamens 5. Racemes terminal.

Ochna, Schreb.

Conspectus of species.

* Styles free at the summit for nearly a line length.

Fruiting sepals erect-conniving; filaments as long or longer than the anthers; tree, ... *O. Andamanica.*

* * Styles united to the apex.

× Filaments as long or longer than the anthers.

Petals usually 5; fruiting sepals reflexed; tree, ... *O. Wallichii.*

Petals 5; fruiting sepals erect-connivent; dwarf shrub, ... *O. fruticulosa.*

× × Filaments almost 4 times shorter than the anthers.

Petals usually 7—8; fruiting sepals erect-conniving; tree, ... *O. squarrosa.*

1. O. ANDAMANICA, Kurz in Journ. As. Soc. Beng. 1872, 295.

HAB. Frequent in the tropical forests of the Andamans.—Fl. March; Fr. May, June.

2. O. SQUARROSA, Roxb. Corom. Pl. I. t. 89 and Fl. II. 643; Wight Ill. t. 69. (*O. lucida,* Lamk. Dicot. IV. 510).

HAB. Ava (Mrs. Col. Burney).

3. O. WALLICHII, Planch. in Hook. Lond. Journ. V. 650; Hf. Ind. Fl. I. 524, excl. syn. Colebr. and Kurz. (*O. obtusata,* Wall. Cat. 28051; *O. lucida,* Griff. Not. Dicot. 464).

HAB. Very frequent in the tropical forests of Martaban and Tenasserim; less so along the eastern and southern slopes of the Pegu Yomah.—Fl. March; Fr. Apr. May.

4. O. FRUTICULOSA, Kurz in Journ. As. Soc. Beng. 1872, 295.

HAB. Frequent in the open forests, especially the eng-forests, all over Pegu and Martaban.—Fl. Apr. May; Fr. June, July.

Doubtful species.

1. *O. parviflora,* Griff. Not. Dicot. 464.

HAB. Forests of Moulmein.

Referred by Bennet as a variety to *O. Wallichii,* from which it seems to differ by its smaller flowers. I have not seen a specimen and the reflexed sepals seem to confirm Mr. Bennet's conclusion.

2. *O.? brevipes,* Planch. in Hook. Lond. Journ. Bot. V. 652; Hf. Ind. Fl. I. 525.

HAB. Pegu.

Gomphia, Schreb.

1. G. Sumatrana, Jack. Mal. Misc. V. 29; Hf. Ind. Fl. I. 525.—(*G. Sumatrensis*, Planch. in Hook. Icon. t. 712; *Ochna crocea*, Griff. Not. Dicot. 463).

Hab. Tenasserim, Mergui, along the sea-coast of the island Madamaca, Pator. (Griff.).

N. B.—Mr. Bennet has a *Tetramerista glabra* var. *sagittata*, based upon *Ancistrocladus ? sagittatus*, Wall. Cat. 1055, a plant which I have not seen, and which on account of its sagittate-based leaves cannot be a *Tetramerista.* He gives Tenasserim as one of the localities for it.

BURSERACEÆ.

Conspectus of genera.

(*In Burmese species the fruit is an indehiscent drupe.*)

Garuga. Torus broadly filling the urceolate calyx-tube. Calyx 5-cleft.

Bursera. Calyx small, 4—6-parted. Stamens 8—12, inserted at the base of the annular disk.

Canarium. Calyx 3-(rarely 2—5) cleft, valvate. Petals 3—5. Stamens 6—10. Drupes ovoid, more or less 3-angular, with a bony or hard putamen.

Garuga, Roxb.

1. G. pinnata, Roxb. Corom. Pl. III. t. 208 and Fl. Ind. II. 400; Bedd. Fl. Sylv. t. 118; Hf. Ind. Fl. I. 528.

Var. α. genuina, more glabrescent; drupes glabrous.

Var. β. mollis (*G. mollis*, Turcz. in Bull. Nat. Mosc. 1858, 457), more pubescent or villous, the drupes densely villous or pubescent.

Hab. Common in the mixed forests all over Burma from Chittagong and Ava down to Tennasserim and the Andamans, up to 3000 ft. elevation; var. β. with the typical form.—Fl. Febr. March; Fr. Begin. of R. S.

Bursera, L.

1. B. serrata, Wall. in Trans. Linn. Soc. XV. 362. t. 4.; Hf. Ind. Fl. I. 530.—(*Limonia pentagyna*, Roxb. Fl. Ind. II. 382).

Hab. Frequent in the tropical forests, especially along choungs, of the eastern slopes of the Pegu Yomah and Martaban.—Fl. Apr.

Canarium, L.

Conspectus of species.

* Stipules subulate, entire, very deciduous.

Leaflets serrulate; disk-glands smooth, 6, free, cohering by pairs, ... *C. euphyllum.*

Leaflets entire; disk-lobes 3, hairy, united into a cup, ... *C. Bengalense.*

* * Stipules 2-cleft and pectinately cut, persistent.

Young buds covered by the crimson velvety bracts; leaflets entire and serrate, .. *C. coccineo-bracteatum.*

1. C. EUPHYLLUM, Kurz in Journ. As. Soc. Beng. 1872, 295; Hf. Ind. Fl. I. 535.

HAB. Frequent in the tropical forests of South Andaman.—Fl. June.

2. C. BENGALENSE, Roxb. Fl. Ind. III. 136; Hf. Ind. Fl. I. 534.

HAB. Very rare in the moister upper-mixed forests of the Pegu Yomah.

3. C. COCCINEO-BRACTEATUM, Kurz in And. Rep. App. B. 4. and Journ. As. Soc. Beng. 1872. 296; Hf. Ind. Fl. I. 536.

HAB. Rather rare in the tropical forests of South Andaman.—Fl. May.

N. B.—*C. nitidum*, Bennet = *C. patentissimum*, Miq.; *C. grandiflorum*, Bennet = *C. Mahassan*, Miq. Besides these Maingay's No. 310 = *C. eupteron*, Miq., and ejusd. No. 307 = *C. rugosum*, Miq.

MELIACEÆ.

Conspectus of genera.

A. Ovary-cells 1—2 ovuled. Seeds not winged.

Trib. I. MELIEÆ. Stamens united into a tube. Albumen thin, fleshy. Cotyledons thin, leafy or plano-convex.

* Capsule loculicidally 5-valved.

MUNRONIA. Calyx-lobes 5, almost leafy. Petals adnate to the elongate staminal tube. Disk tubular, sheathing the ovary. Leaves pinnate or pinnately 3-foliolate.

* * Fruit a drupe.

MELIA. Calyx 5—6-parted. Petals free. Disk annular. Drupes containing a single 1—5-celled putamen. Leaves pinnate or decompound.

CIPADESSA. Calyx 5-toothed. Petals free, short. Disk cupular. Drupes containing 5 horny pyrenes.

Trib. II. TRICHILIEÆ. Stamens united into a tube, very rarely free. Ovary-cells with one or two, rarely more ovules. Albumen none. Cotyledons thick.

* Disk free, tubular or cylindrical. Style usually elongate.

O Leaves pinnate (leaflets 5 or more).

DYSOXYLON. Calyx small, 4- or 5-toothed, opened while in young bud. Petals valvate, free. Ovary 3—5-celled. Capsule pear-shaped, opening loculicidally. Arillus none.

DIDYMOCHITON. Calyx small or large, consisting of 5—7 distinctly imbricate sepals. Petals valvate, adnate to the lobed or toothed staminal tube for nearly $\frac{1}{4}$ of their length. Capsule globose, berry-like, opening loculicidally. Arillus none.

SCHIZOCHITON. Calyx usually campanulate, obscurely 4- rarely 5-toothed, open already in bud. Petals valvate or imbricate, united for $\frac{1}{3}$ to nearly $\frac{1}{2}$ of their length with the toothed or lobed staminal tube and appearing tubular. Ovary 3—4-celled. Capsule usually pyriform, opening loculicidally. Arillus complete or incomplete.

O O Leaves pinnately 3-foliolate.

SANDORICUM. Calyx tubular. Petals imbricate. Berry globular, indehiscent.

* * Disk none, or annular or stalk-like, or confluent with the staminal tube. Style usually short or none.

† Anthers included, or almost included in the staminal tube. Seeds arillate.

AGLAIA. Petals 5. Anthers as many. Ovary 1—3-celled. Berry 1—2-celled, indehiscent.

AMOORA. Petals 3—5. Anthers twice as many or more than twice as many as petals. Ovary 3—5-celled. Capsule leathery, opening loculicidally.

† † Anthers exserted or the filaments upwards free.

WALSURA. Petals 5. Berry indehiscent or follicular-dehiscing along the suture. Seeds arillate.

B. Ovary-cells 3- to many-ovuled. Seeds usually winged.

Trib. III. SWIETENIEÆ. Stamens united into a tube. Albumen present or not. Leaves pinnate.

CARAPA. Petals 4 or 5. Ovary-cells with 6 to 3 ovules. Capsule usually large, thick coriaceous, opening loculicidally. Seeds very large, with corky testa, without arillus, not winged.

SOYMIDA. Petals 5. Staminal tube cup-shaped, 10-lobed, the lobes 2-toothed. Disk rather broad. Seeds winged at both ends. Albumen none.

CHICKRASSIA. Petals 4 or 5. Staminal tube cylindrical, 10-crenate. Disk none. Seeds winged below. Albumen none.

Trib. IV. CEDRELEÆ. Filaments free, inserted outside of the disk. Valves of capsule separating from the axis. Seeds many. Leaves pinnate.

CEDRELA. Petals erect. Stamens 4—6. Disk raised or thin. Ovary 5-celled. Capsule opening septicidally. Seeds winged.

Munronia, Wight.

1. M. WALLICHII, Wight. Ill. Ind. Bot. 147; Hf. Ind. Fl. I. 543.—(*Turraea pinnata*, Wall. Pl. As. var. II. 21. t. 119; Bot. Mag. t. 1413; *M. Neilgherrica*, Wight Ill. I. 147. t. 54).

HAB. Rare on shady moist sandstone-rocks in the tropical forests of the central parts of the Pegu Yomah (Toung-nyo choung).—Fl. March.

Melia, L.

Conspectus of species.

* *Leaves simply pinnate. Ovary 3-celled.*

Leaflets entire, ... *M. excelsa.*

Leaflets serrate; drupes small, by abortion one-celled and 1-seeded, .. *M. Azadirachta.*

* * *Leaves twice pinnate. Ovary and drupes 5—8-celled, some of the cells in fruit usually empty.*

× Drupes about $\frac{1}{2}$ in. long, oblong or elliptical.

Leaflets serrate; staminal tube blue or dark lilac, slender, glabrous outside, about 3 lin. long, ... *M. Azedarach.*

× × Drupes large, 1 in. long or longer. Staminal tube white.

Drupes ovate, hardly $\frac{1}{2}$ in. thick, 5 or fewer-celled; staminal tube about $1\frac{1}{2}$—2 lin. long, glabrous outside; leaflets crenate or ultimately entire, ... *M. dubia.*

Drupes twice as large, almost globose-obovoid, 5—8-celled; staminal tube 2 lin. long, woolly at the summit; flowers larger, scurvy-tomentose outside, ... *M. Birmanica.*

1. M. EXCELSA, Jack in Mal. Misc. I. 12; Griff. Not. Dicot. 499; Hf. Ind. Fl. I. 544.

HAB. Tenasserim, Mergui, probably cultivated.—Fl. Decb.

2. M. AZADIRACHTA, L. sp. pl. 550; Roxb. Fl. Ind. II. 394; Griff. Not. Dicot. 500; Bedd. Fl. Sylv. t. 14.; Hf. Ind. Fl. I. 544.—(*Azadirachta Indica*, A. Juss. in Mem. Mus. XIX. t. 13; Wight Icon. t. 17).

HAB. Not unfrequent in the dry forests of Prome District, especially on the higher ridges of the Yomah; also Ava.—Fl. March.

3. M. AZEDARACH, L. sp. pl. 550; Roxb. Fl. Ind. II. 395; Bot. Mag. t. 1066; Wight Icon. t. 160; Bedd. Fl. Sylv. t. 13; Hf. Ind. Fl. I. 544.—(*Melia sempervirens*, Sw. Prod. 67; Roxb. Fl. Ind. II. 395; Bot. Reg. t. 643; *M. sambucina*, Bl. Bydr. 162).

HAB. Prome and Ava, in and around villages, apparently only cultivated, wild in the adjoining Siamese provinces.—Fl. Febr. March; Fr. March, Apr.

4. M. BIRMANICA, Kurz in Journ. As. Soc. Beng. 1874. 183.

HAB. Frequent in the tropical forests of Martaban.—Fl. March, Apr.; Fr. Apr. May.

Cipadessa, Bl.

1. C. BACCIFERA, Miq. in Ann. Mus. Lugd. Bat. IV. b.—(*Melia baccifera*, Roth. Nov. sp. 215; *Ekebergia Indica*, Roxb. Fl. Ind. II. 392; *C. fruticosa*, Bl. Bydr. 162; Hf. Ind. Fl. I. 545; *Mallea Rothii*, A. Juss. in Mém. Mus. XIX. 222. t. 13. f. 6).

VAR. α. ROTHII, leaflets coarsely serrate or serrate-toothed.

VAR. β. INTEGERRIMA, leaflets all entire.

HAB. Var. β. Ava, Taong-dong (Wall.)—Fl. Nov.

Dysoxylum, Bl.

Conspectns of species.

× Flowers in panicles.

Calyx petals and reproductive organs perfectly glabrous, ... *D. binectariferum.*

Calyx petals and staminal tube minutely pubescent, ... *D. procerum.*

× × Flowers in spikes or racemes.

Spikes arising from the trunk or old branches, densely flowered; leaflets opposite or nearly so, pale green, ... *D. cauliflorum.*

1. D. BINECTARIFERUM, Bedd. in Linn. Trans. XXV. 212; Hf. Ind. Fl. I. 546.—(*Guarea binectarifera*, Roxb. Fl. Ind. II. 240; *D. macrocarpum*, Thw. Ceyl. Pl. 60? Bedd. Fl. Sylv. t. 150?).

HAB. Chittagong; forests of South Andaman? (leaves only).—Fl. June; Fr. Febr.

2. D. PROCERUM, Hiern in Hf. Ind. Fl. t. 547.

HAB. Rare in the tropical forests of the southern slopes of the Pegu Yomah; more frequent in those of Tenasserim.—Fl. Decb.

N. B.—D. brevipes, Hiern = *D. costulatum*, Miq., in spite of a slight difference in the indument of ovary and tube.

3. D. CAULIFLORUM, Hiern in Hf. Ind. Fl. I. 549.

HAB. Tropical forests of South Andaman.

Schizochiton, Bl.

Conspectus of species.

* Flowers almost sessile or very shortly and robustly pedicelled.

Leaflets quite glabrous; anthers 6, ... *Sch. dysoxylifolius.*

Leaflets softly pubescent beneath; anthers 6—7, ... *Sch. grandiflorus.*

* * Flowers on slender pedicels.

Young parts and panicle and also the under-surface of leaves pubescent, *Sch. paniculatus.*

1. SCH. DYSOXYLIFOLIUS, Kurz in Journ. As. Soc. Beng. 1871. 49.—(*Chisogeton dysoxylifolius*, Hiern in Hf. Ind. Fl. I. 551).

HAB. Upper Tenasserim, Thounggyeen.—Fl. March.

2. SCH. GRANDIFLORUS, Kurz in Journ. As. Soc. Beng. 1872. 296.—(*Chisogeton grandiflorus*, Hiern in Hf. Ind. Fl. I. 552).

HAB. Frequent in the tropical forests of Martaban and Tenasserim.—Fl. March, Apr.

3. SCH. PANICULATUS, Hiern in Hf. Ind. Fl. I. 552.—(*Guarea paniculata*, Roxb. Fl. Ind. II. 242).

HAB. Burmah, probably Martaban (Brandis); Tenasserim, Tavoy (*teste* Hiern); Ava, on Taong dong (Wall. Cat. 8099. pp. mixed up with *Chickrassia* leaves).

N. B.—Chisocheton holocalyx, Hiern = *Schizochiton patens*, Spreng.

Sandoricum, Cav.

1. S. INDICUM, Cav. Diss. VII. t. 202. 203; Roxb. Fl. Ind. II. 392. and Corom. Pl. III. t. 261; Hf. Ind. Fl. I. 553.

HAB. Indigenous in the tropical forests of the southern slopes of the Pegu Yomah and in Tenasserim; much cultivated in Burmese villages.—Fl. Jan.; Fr. Apr. May.

Aglaia, Lour.

Conspectus of species.

* Inflorescence and often also the other parts more or less scaly especially while young.

× Leaflets usually in 2 or 1 pair with an odd one, nearly glabrous.

Leaves pinnately 3-foliolate; panicles short and peduncled; scales of younger parts pale coloured, ... *A. Chittagonga.*

Leaflets in 2 pairs with an odd one; scales of younger parts pale coloured; panicle small sessile, ... *A. Andamanica.*

Leaflets in 2 pairs with an odd one; scales of younger parts rusty brown; panicles ample, about as long to half as long as the leaves, rather long-peduncled, *A. paniculata.*

× × Leaflets usually in 8—5 pairs with an odd one, beneath densely silvery or coppery scaly.

Panicle ample, densely silvery or coppery lepidote; flowers sessile, ... *A. argentea.*

* * Calyx pedicels and usually the whole inflorescence rusty puberulous or tomentose from short stellate hairs.

× Leaflets in 6—8 or more pairs.

Leaflets beneath minutely and indistinctly scaly-tomentose, glabrescent, the lateral nerves all sharply prominent beneath; panicles, etc. rusty puberulous; flowers pedicelled; berries tawny velvety, ... *A. crassinervia.*

Leaflets beneath sparingly fascicled-hairy, petiole panicle and nerves beneath densely rusty tomentose, ... *A. Griffithii.*

× × Leaflets in 1 or 2 pairs with an odd one, rarely 1-foliolate.

Panicles slightly stellately pubescent, soon glabrous; calyx and pedicels glabrous; net-venation conspicuous, ... *A. oligophylla.*

1. A. Chittagonga, Miq. in Ann. Mus. Lugd. Bat. IV. 44.

Hab. Tropical forests of Chittagong and Arracan.

N. B.—Hiern apparently identifies the fruiting specimens No. 13 of Hb. Hf. and Th. with the perfectly different flowering ones collected by Griffith (viz. Nos. 1074 and 1066 Hb. Griff.) which belong to my *Amoora lactescens.*

2. A. Andamanica, Hiern in Hf. Ind. Fl. I. 555.

Hab. Not unfrequent in the tropical forests of the Andamans.—Fr. Febr.

3. A. paniculata, Kurz Hb. 2043.

Hab. Rather rare in the tropical forests of the Pegu Yomah; Tenasserim (Helf. 1036—1037).

4. A. argentea, Bl. Bydr. 170; Miq. in Ann. Mus. Lugd. Bat. IV. 54.

Hab. Rare in the tropical forests of the eastern slopes of the Pegu Yomah.

5. A. crassinervia, Kurz in Hf. Ind. Fl. I. 556.—(*Cupania sp.* Wall. Cat. 8067. B).

Hab. Tenasserim (Helf. 1038).

6. A. Griffithii (*A. minutiflora, β. Griffithii,* Hiern in Hf. Ind. Fl. 557; *Euphoria exstipulata,* Griff. Not. Dicot. 547.

Hab. Tenasserim (Helf. 1039); Mergui (Griff.).

7. A. oligophylla, Miq. Suppl. Fl. Sum. 507 and Ann. Mus. Lugd. Bat. IV. 41.—(*Meliacea Singapureana,* Wall. Cat. 4887).

HAB. Tenasserim (Helf. 1046).

I have only fragments of the Wallichian plant, which so far agree.

A. Roxburghiana, as understood by Mr. Hiern, is a heterogeneous assemblage which, besides the above, includes also the Khasyan *A. undulata*, Miq. Ann. Mus. Lugd. Bat. IV. 44 (= *Milnea sp.* 17. Hf. and Th., referred by Hiern to *A. edulis*).

Amoora, Roxb.

Conspectus of species.

* Petals 3. Anthers 6—8.

× Flowers sessile, spiked, the male spikes forming large panicles.

Leaflets shortly acuminate; fertile spikes simple, many-flowered; male flowers about 4 lin. in diameter, the staminal tube entire at the apex, ...*A. Rohituka.*

× × Flowers pedicelled, cymose or racemose-cymose and panicled.

O Male panicles ample, as long to half as long as the leaves.

Leaflets shortly acuminate, thin coriaceous, the nerves prominent on both sides, the veins and net-venation distinct, ...*A. spectabilis.*

Leaflets blunt, smaller, coriaceous, the nerves above hardly visible and impressed, the veins and net-venation obsolete; fertile spikes few-flowered; flowers about 2 lin. in diameter, the staminal tube slightly 3-toothed, ...*A. cucullata.*

O O Panicles slender, shorter or as long as the petiole.

Leaflets green, conspicuously nerved and net-veined on both sides; flowers long pedicelled; panicle very lax, densely lepidote, ...*A. lactescens.*

* * Petals 5. Stamens 10.

Panicles shorter than the petiole, like the petiole densely lepidote; leaves sparingly lepidote beneath,..*A. dysoxyloides.*

1. A. ROHITUCA, WA. Prodr. I. 119; Bedd. Fl. Sylv. t. 132; Hf. Ind. Fl. I. 559.—(*Andersonia Rohituka*, Roxb. Fl. Ind. II. 213; Griff. Not. Dicot. 507. t. 589. f. 3).

HAB. Frequent in the tropical forests of the eastern slopes of the Pegu Yomah, and from Martaban down to Tenasserim, up to 3000 feet elevation.—Fl. Apr. May.

2. A. SPECTABILIS, Miq. Ann. Mus. Lugd. Bat. IV. 37; Hf. Ind. Fl. I. 561.

HAB. Rangoon (*teste* Hiern).

I have seen no Burmese specimens; the original Wallichian tree came from Assam (Gwálpára) and not from Nepal.

3. A. CUCULLATA, Roxb. Corom. Pl. III. 54. t. 258; Hf. and Ind. Fl. I. 560. (*Andersonia cucullata*, Roxb. Fl. Ind. III. 212).

HAB. Forests of Lower Pegu and Tenasserim.—Fl. Sept.

4. A. LACTESCENS, Kurz MS.

HAB. Rather rare in the tropical forests of Martaban, east of Toungoo (Hb. Kz. 1381).

5. A. DYSOXYLOIDES, Kurz MS.

HAB. Martaban, Yoonzeleen, at 900 feet elevation (Brandis).

Walsura, Roxb.

Conspectus of genera.

Subg. 1. *EUWALSURA.* Berries indehiscent or only very slowly and incompletely dehiscing along the sutures, usually velvety or tomentose.

* *Panicles densely pubescent. Young shoots and petioles of young leaves puberulous.*

Petals pubescent; filaments flat, at the very broad base somewhat coherent, .. *W. trichostemon.*

* * *Panicles minutely puberulous; leaves and petioles glabrous.*

O Leaves coriaceous or firmly chartaceous.

Leaves beneath usually white-areolate within the net-venation; filaments broadly lanceolate, sprinkled with minute hairs, ... *W. robusta.*

Leaflets uniformly glaucous beneath; filaments linear, densely pubescent; flowers larger, ... *W. hypoleuca.*

O O Leaves thin chartaceous or almost membranous, the net-venation very thin and inconspicuous.

Leaves acuminate, uniformly glaucous beneath; young fruits acuminate, greyish velvety, ... *W. oxycarpa.*

Subg. 2. *HEYNEA*, Roxb. Berries dehiscing along the sutures, usually glabrous.

Glabrous or pubescent; leaflets in 3—6 pairs; panicles long-peduncled, ... *W. trijuga.*

1. W. TRICHOSTEMON, Miq. in Ann. Mus. Lugd. Bat. IV. 60.—(*W. villosa*, WA. Prod. I. 120. in adn., nomen nudum; Hf. Ind. Fl. I. 564.)

HAB. Frequent in the eng and low forests from Pegu and Martaban down to Tenasserim; also Ava.—Fl. March, Apr.; Fr. May, June.

N. B.—Wall. Cat. 8113 from Sylhet, which, according to Hiern, differs from the known species of *Walsura*, is *W. tubulata*, Hiern.

2. W. ROBUSTA, Roxb. Fl. Ind. II. 386; Hf. Ind. Fl. I. 565.

HAB. Rather rare in the tropical forests of the eastern slopes of the Pegu Yomah, but frequent in those of Martaban down to Tenasserim and the Andamans.—Fl. May; Fr. July.

3. W. HYPOLEUCA, Kurz in Journ. As. Soc. Beng. 1872. 296 excl. fruct.; Hf. Ind. Fl. I. 564.

HAB. Frequent in the tropical forests of the Andamans.—Fl. May, June.

4. W. OXYCARPA, Kurz MS.

HAB. Not unfrequent in the tropical forests of the Andamans.

5. W. TRIJUGA (*Heynea trijuga*, Roxb. Corom. Pl. III. 56. t. 260. and Fl. Ind. II. 390; Bot. Mag. t. 1738; Hf. Ind. Fl. I. 565.—(*Heynea quinquejuga*, Roxb. Fl. Ind. II. 391).

VAR. α. GENUINA, all parts (also the panicle) quite glabrous, or only the young shoots slightly pubescent; leaflets in 3 to 6 pairs.

VAR. β. PUBESCENS, (*Walsura pubescens*, Kurz in Journ. As. Soc. Beng, 1872. 397), all softer parts, inflorescence, and under surface of leaves, softly pubescent; leaflets usually in 4 pairs.

HAB. Var. α. Upper Tenasserim ; var. β. rather rare in the tropical forests along the eastern slopes of the Pegu Yomah, and in the Martaban hills, up to 2000 feet elevation.—Fl. Febr. March ; Fr. Apr.

Carapa, Aubl.

Conspectus of species.

Leaflets more or less ovate ; flowers 5-merous, about 2 lin. across, ... *C. Moluccensis.*
Leaflets obovate to obovate-oblong ; flowers 4-merous, about 4 lin. across, .. *C. obovata.*

1. C. MOLUCCENSIS, Lam. Encycl. Meth. I. 621 ; DC. Prod. I. 626. (*Granatum littoreum*, Rumph. Herb. Amb. t. 61. ; *Xylocarpus Granatum*, Koen. Naturf. XX. 2 ; A. Juss. in Mém, Mus. XIX. 244 ; Miq. Ann. Mus. Lugd. Bat.).

HAB. Not unfrequent along the rocky and sandy shores of the Andamans, especially along the western side.—Fr. Apr. May.

2. C. OBOVATA, Bl. Bydr. 179. (*Xylocarpus obovatus*, A. Juss. in Mém. Mus. XIX. 344 ; Miq. in Ann. Mus. Lugd. Bat. IV. 62 ; *Xylocarpus Granatum*, Roxb. Fl. Ind. II. 240 ; *Monosoma littorata*, Griff. Not. Dicot. 502. t. 588. f. 3. ; *Guarea oblongifolia*, Griff. Not. Dicot. 503 ?).

HAB. Frequent in the littoral forests, especially the tidal ones, all along the shores, from Chittagong down to Tenasserim and the Andamans.—Fl. June, July ; Fr. Apr. May.

Chickrassia, A. Juss.

1. Ch. TABULARIS, A. Juss. in Mém. Mus. XIX. 251. t. 22. f. 27 ; Wight Ill. t. 56 ; Bedd. Fl. Sylv. t. 9 ; Hf. Ind. Fl. I. 568.—(*Swietenia Chickrassa*, Roxb. Fl. Ind. II. 399).

Var. α. GENUINA, leaves and panicles glabrous ; capsules greyish, wrinkled-rough.

Var. β. VELUTINA (*Chickrassia velutina*, Roem. Syn. monog. I. 135 ; Kurz in Journ. As. Soc. Beng. 1873. 65), all softer parts, as well as the panicle, softly pubescent ; capsules black, almost smooth.

HAB. Var. α. Rather rare in the tropical forests of Chittagong and Pegu down to Tenasserim ; also Andamans ; var. β. frequent in the dry forests of Prome and Pegu, here entering also the upper mixed forests.—Fl. Sept.

Soymida, A. Juss.

1. S. FEBRIFUGA, A. Juss. in Mém. Mus. XIX. 251. t. 22. f. 26 ; Bedd. Fl. Sylv. t. 8 ; Hf. Ind. Fl. I. 567.—(*Swietenia febrifuga*, Roxb. Corom. Pl. I. t. 17. and Fl. Ind. II. 398).

HAB. Burmah (in Hb. Brandis, without locality, probably Prome).—Fl. March, Apr. ; Fr. Jul. Aug.

Cedrela, L.

Conspectus of species.

* Seeds winged at both ends. Leaflets entire.

Calyx minute, the sepals rounded, hardly $\frac{1}{3}$ lin. long; leaflets usually on long slender petiolules, ... *C. Toona.*

Calyx large, the sepals $1\frac{1}{2}$ lin. long, rather acute; leaflets usually shortly petioluled, .. *C. multijuga.*

* * Seeds winged only below.

Leaflets serrate or serrulate; calyx minute, ... *C. serrata.*

1. C. Toona, Roxb. Corom. Pl. III. t. 238 and Fl. Ind. I. 635; Wight. Icon. t. 161; Brand. Fl. Sylv. 72. t. 14, Bedd. Fl. Sylv. t. 10; WA. Prod. I. 124.—(*C. febrifuga*, Bl. Bydr. 180; Miq. in Ann. Mus. Lugd. Bat. IV. 63; *C. Teysmanni*, Hort. Bog. 133; Miq. l. c.).

Hab. Rather rare in the tropical forests of the Pegu Yomah, frequent in those of Martaban; also Chittagong and Arracan.—Fl. March, Apr.; Fr. Oct. Nov.

2. C. multijuga, Kurz in Journ. As. Soc. Beng. 1872. 297.

Hab. Rather rare in the tropical forests of the eastern slopes of the Pegu Yomah, west of Toungboo.—Fl. March.

3. C. serrata, Royle. Ill. Him. Pl. 144. t. 25.—(*C. serrulata*, Miq. Suppl. Fl. Sum. 508 and Ann. Mus. Lugd. Bat. IV. 64; *C. longifolia*, Wall. Cat. 1273).

Hab. Ava.

The identification of *C. serrulata*, Miq. (which is the same as Wallich's plant) with *C. serrata*, Royle, is open to future inquiry.

CHAILLETIACEÆ.

Chailletia, DC.

Conspectus of species.

× Nerves and net-venation beneath more or less conspicuous.

Cymes cluster-like and almost sessile; leaves green, cuneately narrowed into a very short petiole, ... *Ch. gelonioides.*

Cymes spreading, peduncled ?; leaves dark-brown in a dried state, ... *Ch. macropetala.*

× × Nerves and net-venation beneath very faint and almost impressed.

Cymes on a peduncle 2—3 lin. long; leaves brown in a dried state, shortly petioled, .. *Ch. Helferiana.*

1. Ch. gelonioides, Bth. and Hf. Gen. pl. I. 341. and Hf. Ind. Fl. I. 570 excl. syn. Miq. (*Moacurra gelonioides*, Roxb. Fl. Ind. II. 70; DC. Prod. XV/2. 227).

Hab. Chittagong.

N. B.—*Ch. Sumatrana*, Miq. has fruits only one-third or one-fourth the size of those of *Ch. gelonioides,* not to mention other points of difference.

2. Ch. macropetala, Turcz. in Bull. Mosc. 1863. 611. (*longipetala*); Hf. Ind. Fl. I. 571.

Hab. Tenasserim, Mergui.

3. Ch. Helferiana, Kurz in Journ. As. Soc. Beng. 1872. 297; Hf. Ind. Fl. I. 570.

Hab. Tenasserim, Tavoy, Moulmein, etc.

OLACINEÆ.

Conspectus of species.

Subord. I. Olaceæ. Stamens as many or twice as many (rarely fewer) as petals and *opposite to them.*

Trib. I. EU-OLACEÆ. Stamens anisomerous, or isomerous. Ovary 2—5-celled at the base, 1-celled at the apex or completely 1-celled, the placenta central with 2—5 pendulous ovules.

* Stamens twice as many as petals, or if fewer, accompanied by staminodes.

Ximenia. Calyx not enlarging after flowering. Stamens all perfect.

Olax. Calyx enlarging and enclosing the fruit. Perfect stamens 3, rarely 5; staminodes 6 or fewer.

* * Stamens as many as petals. Staminodes none.

× Fruiting calyx much enlarged, adnate to the drupe.

Erythropalum. Ovary 1-celled. Tendril-bearing climbers with 3-nerved leaves.

Strombosia. Ovary to near the summit 3—5-celled. Trees with penninerved leaves.

× × Calyx in fruit unchanged.

Anacolosa. Disk in fruit much enlarged, adnate to the drupe and resembling an engrossed adnate calyx. Petals almost. Ovary 1 or imperfectly 2-celled.

Trib. II. OPILIEÆ. Stamens isomerous. Ovary 1-celled with a single ovule. Flowers hermaphrodite.

* *Perianth dichlamydeous, i. e. consisting of calyx and corolla.*

Cansjera. Spikes axillary, without bracts. Calyx inconspicuous, shortly 4-lobed; corolla gamopefalous. Stamens 4, alternating with as many hypogynous scales or glands.

Natsiatopsis. Spikes axillary, without conspicuous bracts. Calyx 4-lobed. Corolla gamopetalous. Stamens 4, free. Staminodes none.

Opilia. Inflorescence while young conspicuously imbricate-bracted. Petals free. Filaments filiform. Staminodes 5.

* * *Perianth monochlamydeous.*

Lepionurus. Inflorescence while young conspicuously imbricate-bracted. Flowers 4-merous. Filaments very short, complanate.

Champereya. Inflorescence with very deciduous minute bracts. Flowers 5-merous. Filaments slender, exserted.

Subord. II. Icacineæ. Stamens as many as petals and *alternating with them.*

Trib. III. EU-ICACINEÆ. Cotyledons small or dilated. Trees or erect shrubs.

* Calyx minutely toothed or lobed. Petals usually glabrous.

Stemonurus. Anthers pendulous. Drupe without fleshy appendage.

Apodytes. Anthers attached at the back above the 2-lobed base. Ovary oblique. Drupe with a fleshy puffy sarcocarp covering only the one half of the nut.

DAPHNEPHYLLOPSIS. Anthers attached to the back. Drupe berry-like. Flowers sessile, in heads.

* * Calyx 5-cleft or the sepals distinct, imbricate.

GONOCARYUM. Flowers unisexual. Drupes dry, woody. Albumen many-lobed.

Trib. IV. PHYTOCRENEÆ. Cotyledons broadly foliaceous or thick-fleshy. Flowers diœcious. Climbers. Fruit drupaceous.

* Stamens alternating with the petals.

× Flowers in heads.

PHYTOCRENE. Filaments longer than the anthers. Albumen deeply lobed. Drupes villous or echinate.

× × Flowers in spikes racemes or panicles.

SARCOSTIGMA. Flowers interruptedly spiked; filaments longer than the anthers. Staminodes none. Stigma sessile. Albumen none.

NATSIATUM. Flowers racemose. Filaments very short, alternating with 5 staminodes. Styles 2. Albumen fleshy.

* * Stamens opposite to the petals.

JODES. Flowers cymose-panicled. Stamens 8, filaments very short. Stigma sessile. Albumen fleshy.

Genus of doubtful position.

CARDIOPTERIS. Sepals and petals imbricate. Fruit dry, winged. Milk-juiced annual twiners.

Ximenia, L.

1. X. AMERICANA, L. sp. pl. 497; Roxb. Fl. Ind. II. 252; Lamk. Ill. t. 257. f. 1—2; Bth. Fl. Austr. I. 391; Hf. Ind. Fl. I. 574.—(*X. subscandens*, Griff. Not. Dicot. 691).

HAB. Not unfrequent along the coasts of the Andamans; also Tenasserim.—Fl. March, Apr.

Olax, L.

Conspectus of species.

× Enlarged calyx in fruit membranous, dry.

Branchlets terete, like the under-surface of the leaves and the racemes, puberulous, .. *O. scandens.*

All parts also the racemes quite glabrous; branchlets angular, ... *O. zeylanica.*

× × Enlarged fruiting calyx coriaceous (fleshy in a fresh state).

Glabrous, the branchlets terete; flowers 4—5 lin. long, ... *O. imbricata.*

1. O. SCANDENS, Roxb. Corom. Pl. II. t. 102. and Fl. Ind. I. 163; Hf. Ind. Fl. 575.—(*Olax obtusa*, Bl. Bydr. 131?).

HAB. Rather frequent all over Burmah, from Ava and Chittagong down to Tenasserim, in all deciduous forests, ascending also the pine forests up to 3500 ft. elevation, and occurring equally abundantly in the tidal forests.—Fl. Decb.—March.

2. O. ZEYLANICA, L. sp. pl. 49; Hf. Ind. Pl. I. 576. (*O. acuminata*, Wall. Cat. 6781; Hf. Ind. Fl. 1. 576; *O. sphaerocarpa*, Griff. Not. Dicot. 689).

HAB. Ava, in woods at the Mogoung river (Griff. 797); Khakhyen hills (J. Anderson).—Fl. March.

3. O. IMBRICATA, Roxb. Fl. Ind. I. 164; Hf. Ind. Fl. I. 575.—(*O. Merguensis*, Mast. in Hf. Ind. Fl. I. 576).

HAB. Chittagong; Tenasserim, from Moulmain to Mergui.—Fr. Febr.

Doubtful species.

1. *O. loranthiformis*, Griff. Not. Dicot. 691. t. 645. f. 5.

HAB. Moulmein, on the coast of Madamacan (Griff.).

Erythropalum, Bl.

1. E. SCANDENS, Bl. Bydr. 922; Hf. Ind. Fl. I. 578.—(*Decastrophia inconspicua*, Griff. Not. Dicot 736. t. 613. f. 4.; *E. populifolium*, Planch. in Ann. d. sc. nat. 4 ser. II. 260; Hf. Ind. Fl. I. 578).

HAB. Not unfrequent in the tropical forests of the eastern slopes of the Pegu Yomah, and from Martaban down to Tenasserim.—Fl. Apr.

Strombosia, Bl.

1. S. JAVANICA, Bl. Bydr. 1154, and Mus. Bot. I. 251. f. 47; Hf. Ind. Fl. I. 579.

HAB. Tenasserim (Helf. 818).

Anacolosa, Bl.

Conspectus of species.

Calyx and pedicels densely puberulous; drupe scarlet, thinly velvety, ... *A. puberula.*
Calyx and slender pedicels glabrous, ... *A. Griffithii.*
As preceding, but the fruiting pedicels very thick; drupe an inch long, glabrous, .. *A. crassipes.*

1. A. PUBERULA, Kurz J. A. S. B. 1872. 297; Hf. Ind. Fl. I. 581.

HAB. Rather frequent in the tropical forests of the Andamans.—Fl. Febr. May; Fr. Febr.

2. A. GRIFFITHII, Mast. in Hf. Ind. Fl. I. 580.

HAB. Tenasserim, Mergui (Griff. 821).

Probably only a glabrous form of the preceding; the sepals and petals are not quite glabrous.

3. A. CRASSIPES, (*Stemonurus? crassipes*, Kurz in Journ. As. Soc. Beng. 1872. 298; *Gomphandra? crassipes*, Mast. in Hf. Ind. Fl. I. 587).

HAB. Rare along choungs in the tropical forests of the eastern slopes of the Pegu Yomah.—Fr. CS.

Cansjera, Juss.

Conspectus of species.

× Spikes simple.
Leaves small, oval, notched or blunt, pubescent; spikes very short, solitary, *C. parvifolia.*
Leaves acuminate, opaque; spikes solitary or by pairs, ... *C. Rheedii.*

× × Spikes branched, rarely the uppermost ones almost simple.
Leaves acute, glossy above; spikes solitary, ... *C. zizyphifolia.*

1. C. PARVIFOLIA, Kurz in Journ. As. Soc. Beng. 1872. 298; Hf. Ind. Fl. 583.

HAB. Tenasserim (Helf.).

2. C. RHEEDII, Gmel. Syst. I. 280; Wight Icon. t. 1861; DC. Prod. XIV. 519. Hf. Ind. Fl. I. 582 pp.—(*C. scandens,* Roxb. Corom. Pl. II. 1. t. 103 and Fl. Ind. I. 441).

HAB. Not unfrequent in the tropical forests of the Andamans and Tenasserim.—Fl. May.

3. C. ZIZYPHIFOLIA, Griff. Not. Dicot. 360. t. 537. f. 1. (*Olax? Sumatrana,* Miq. Suppl. Fl. Sum. 342).

HAB. Burmah (Griff. 823, most probably Tenasserim).

Natsiatopsis, Kurz.

1. N. THUNBERGIÆFOLIA, Kurz. MS.

HAB. Ava, Khakhyen hills, Ponsee (J. Anderson).—Fl. March.

Female flowers unknown.

Opilia, Roxb.

1. O. AMENTACEA, Roxb. Corom. Pl. II. 31. t. 158 and Fl. Ind. II. 87; Wight Ill. t. 40; Hf. Ind. Fl. I. 583.

HAB. Not unfrequent in the mixed dry forests of the Prome District. Fl. March; Fr. Apr. May.

Lepionurus, Bl.

1. L. SYLVESTRIS, Bl. Bydr. 1146; Miq. Fl. Ind. Bat. I. 784.—(*L. oblongifolius;* Mast. in Hf. Ind. Fl. I. 583; *Leptonium oblongifolium,* Griff. in Macl. Calc. Journ. IV. 236 and Not. Dicot. 368. t. 536).

HAB. Ava, Khakhyen hills (J. Anderson).—Fl. May.

Champereya, Griff.

1. CH. GRIFFITHIANA, Planch. (*Ch.* sp. Griff. Not. Dicot. 362. t. 537. f. 3).

HAB. Not unfrequent in the tropical forests of the Andaman islands; also Upper Tenasserim.—Fl. Febr.; Fr. Apr. May.

N. B.—Wherever *Lepionurus* may be placed, *Champereya* must accompany it.

Daphniphyllopsis, Kurz.

1. D. CAPITATA, (*Ilex daphnephylloides,* Kurz in Journ. As. Soc. Beng 1870. 72).

HAB. Not unfrequent in the damp hill-forests of Martaban, at 4000 to 6000 ft. elevation.—Fl. March.

An incompletely known genus, but its position in *Olacineæ* is certain. Inflorescence is exactly that of *Ilex sulcata*, while the leaves resemble those of *Daphniphyllum Himalayense.* It is nearest allied to *Mappia.*

Stemonurus, Bl.

Conspectus of species.

× All parts glabrous.

Leaves $2\frac{1}{2}$—5 in. long; cymes leaf-opposite, the peduncle stiff and $\frac{1}{2}$—1 in. long, .. *St. Penangianus.*

Leaves 2—3 in. long; cymes slightly puberulous, axillary and peduncled; drupes elliptically oblong, the putamen sulcate, ... *St. Javanicus.*

× × Younger branchlets tawny tomentose; petioles, undersurface of leaves, and inflorescence puberulous or tomentose.

Cymes peduncled, leaf-opposed, ... *St. tomentellus.*

1. St. Penangianus, Miers Contr. I. 90.—(*Gomphandra Penangiana*, Wall. Cat. 7204; Hf. Ind. Fl. I. 587).

Hab. Upper Tenasserim, Moulmein (Lobb) *teste* Masters.

2. St. Javanicus, Bl. Bydr. 649; Miers. Contr. Bot I. 86.—(*Lasianthera Javanica*, Miq. Fl. Ind. Bat. I/1. 790; *Gomphandra affinis*, Mast. in Hf. Ind. Fl. I. 586).

Hab. Tenasserim.

3. St. tomentellus, Kurz in Journ. As. Soc. Beng. 1872. 298.—(*Gomphandra tomentella*, Mast. in Hf. Ind. Fl. I. 587).

Hab. Burma, probably Tenasserim (Griff. 813).

Apodytes, E. Mey.

1. A. Andamanica, Kurz in And. Rep. App. B. 5. and Journ. As. Soc. Beng. 1872. 298; Hf. Ind. Fl. I. 588.

Hab. Frequent in the tropical forests of the Andaman Islands.—Fl. Febr. to May; Fr. May to July.

Gonocaryum, Miq.

Conspectus of species.

Leaves opaque; drupes obtusely 4—3-angular, acute, ... *G. gracile.*

Leaves glossy; drupes terete, rounded at apex, ... *G. Griffithianum.*

1. G. gracile, Miq. Suppl. Fl. Sum. 343 (1860).—(*Gonocaryum? Wallichii*, Mast. in Hf. Ind. Fl. I. 590).

Hab. Tenasserim (Helf. 817).

The drupes in this species are obtusely angular, but the seeds being all aborted, no stress can, consequently, be laid upon this character, until perfected fruits with seeds become known.

2. G. Griffithianum (*Platea Griffithsiana*, Miers. Contr. I. 97. t. 17; *Platea Lobbiana* Miers. l. c.; *Phlebocalymna Griffithiana*, Mast. in Hf. Ind. Fl. I. 590; *Phlebocalymna Lobbiana*, Mast. l. c.).

HAB. Frequent in marshes of the tropical and swamp forests, from Southern Pegu down to Tenasserim.—Fl. Decb. to March; Fr. R. S.

Phytocrene, Wall.

Conspectus of species.

Male flower-heads usually more tawny, tomentose, on short but very thick pedunclets, numerous in very compound racemes terminating in the young state in short thick tomentose bract-like sterile axes, ... *Ph. gigantea.*

Male flower-heads somewhat smaller and usually greyish, tomentose, on short but slender pedunclets, few (8—5), in simple short racemes terminating in long bract-like greyish-tomentose slender axes, ... *Ph. bracteata.*

1. PH. GIGANTEA, Wall. Pl. As. var. III. 11. t. 216; Griff. Not. Dicot. t. 490. f. 2; Hf. Ind. Fl. I. 591.

HAB. Not unfrequent along choungs in the tropical forests of the eastern slopes of the Pegu Yomah; more frequent in Tenasserim.—Fl. Febr.

2. PH. BRACTEATA, Wall. Fl. As. var. III. 12; DC. Prod. XVII. 12; Hf, Ind. Fl. I. 592.

HAB. South-Tenasserim; Mergui (Griff. 830) *teste* Baillon.

The so-called bracts of the male inflorescences in this genus are, in my opinion, only the sterile end-branchings of the partial racemes.

Sarcostigma, WA.

1. S. WALLICHII, Baill. in Adans. X. 282; DC. Prod. XVII. 16; Hf. Ind. Fl. I. 594.—(*S. edule*, Kurz in Journ. As. Soc. Beng. 1872. 298; Hf. Ind. Fl. I. 594.)

HAB. Frequent in the tropical forests of the Andaman islands.—Fl. Febr.; Fr. May to June.

Masters says that this species (*S. edule*) is probably only a form of *S. Kleinii*, but in this he is mistaken, for the latter differs by quite glabrous drupes and inflorescences; and he evidently confounds two species under this name. I would suggest to him to compare Maingay's No. 378 from Malaya (of which I have seen only leaves) with *S. Horsfieldii.*

Iodes, Bl.

Conspectus of species.

× Pedicels not woody, slender.

Leaves oblong, not cordate at the base, membranous, the petiole $\frac{1}{2}$—$\frac{3}{4}$ in. long; pedicels slender, about $\frac{1}{2}$ lin. long, ... *I. Brandisii.*

Leaves more or less oval, cordate at the base, coriaceous, the petiole 2—4 lin. long; flowers almost sessile, ... *I. tomentella.*

× × Pedicels thick and woody.

Drupes orange, smooth, above an inch long, ... *I. Hookeriana.*

1. I. BRANDISII, Kurz in Journ. As. Soc. Beng. 1872. 298; Hf. Ind. Fl. I. 596.

HAB. Tenasserim, Thoungyeen (Brandis).—Fl. March.

2. I. TOMENTELLA, Miq. Fl. Ind. Bat. I/1. 796.—(*I. ovalis*, Mast. in Hf. Ind. Fl. I. 696, vix. Bl.).

HAB. Upper Tenasserim, Moulmein (Falconer).—Fl. Febr.

3. I.? HOOKERIANA, Baill. in Adans. X. 268; DC. Prod. XVII. 24; Hf. Ind. Fl. I. 596.—(*I. Thomsoniana*, Baill. l. c. 270; DC. l. c. 25; Hf. l. c.).

HAB. Chittagong (Hf. and Th.).

Fruits and habit of *Sarcostigma*. An examination of a single ovary already engrossed shewed me a solitary erect basal ovule.

Cardiopteris, Wall.

1. C. LOBATA, Wall, ap. B. Br. Pl. Jav. Rar. 246. t. 49; Hf. Ind. Fl. I. 597.—(*C. hamulosa*, Griff. Dicot. 542. t. 598. f. 1—3; *C. Javanica*, Bl. Rumph. III. 206. t. 177. f. 1. A.).

HAB. Common in all leaf-shedding forests and deserted toungyas, from Ava and Martaban down to Tenasserim.—Fr. C. S.

ILICINEÆ.

Conspectus of genera.

Subord. I. ILICEÆ. Petals present. Flowers hermaphrodite.

ILEX. Stamens 5. Ovary 4—8-celled.

Subord. II. DAPHNIPHYLLEÆ. Flowers apetalous, unisexual.

DAPHNIPHYLLUM. Stamens 5—18. Ovary 2-celled.

Ilex, L.

Conspectus of species.

* *Male inflorescence cymose, the female flowers clustered or solitary.*

Leaves elongate-cuneate-lanceolate, 2—3½ in. long, beneath very opaque and brown; sepals ciliate, ... *I. gaultheriæfolia.*

* * *Female flowers in simple or compound umbellets or cymes.*

O Cymes head-like contracted and small, on a long compressed peduncle.

Glabrous, or the branchlets pubescent, ... *I. Godayam.*

O O Cymes divaricately 2-cleft, on a rather short peduncle.

Cymes once divaricately 2-cleft; leaves large, coriaceous; branchlets pale-coloured, ..*I. macrophylla.*

Cyme twice or thrice dichotomously branched; leaves beneath pale-coloured or glaucescent; branchlets pure white; style stout, distinct, ... *I. cymosa.*

As preceding, but stigma sessile, ... *I. Wallichii.*

1. I. GAULTHERIÆFOLIA, Kurz in Journ. As. Soc. Beng. 1872. 299.

HAB. Tenasserim, Mergui (Griff. 1998).

Dr. Hooker identifies this species with his *I. theæfolia*, but in this he is in error, his new species differing greatly not only in the texture and polish of the leaves, but still more so in the inflorescence, doubly

larger flowers, and very long pedicels (in my species they are only about ½ lin. long).

2. I. Godayam, Coleb. in. Hf. Ind. Fl. I. 604.—(*Prinos Godayam*, Ham. in Wall. Pl. As. rar. III. 38. t. 261.)

Var. *α.* genuina, shoots, peduncles, and pedicels shortly puberulous; calyx more or less pubescent or densely fringed.

Var. *β.* sulcata, (*I. sulcata*, Wall. Cat. 4330; Hf. Ind. Fl. I. 604), all parts quite glabrous except the puberulous pedicels; calyx usually puberulous or only minutely puberulous, the lobes sometimes ciliolate.

Hab. Var. *β.* Not unfrequent in the tropical forests from Martaban down to Tenasserim.—Fl. Febr. Apr.

3. I. macrophylla, Wall. Cat. 4331; Hf. Ind. Fl. I. 604.

Hab. ? Tenasserim (Helfer), and Mergui (Griff. 2012) *teste* Hf.

4. I. cymosa, Bl. Bydr. 1149; Hf. Ind. Fl. I. 605.

Hab. Tenasserim (*teste* Hf.).

5. I. Wallichii, Hf. Ind. Fl. I. 605.

Hab. Tenasserim, Tavoy (*teste* Hf.).

Daphniphyllum, Bl.

Conspectus of species.

Calyx persistent?; pedicels about ½ in. long, ... *D. majus.*
Calyx deciduous; pedicels about 1—2 lin. long, ... *D. Himalayense.*

1. D. majus, Muell. Arg. in Linn. XXXIV. 76; DC. Prod. XVI/1. 2.

Hab. Upper Tenasserim, Amherst (Wall.) Fl. Febr.

2. D. Himalayense, Muell. Arg. in DC. Prod. XVI/1. 4.

Hab. Not unfrequent in the damp hill-forests of the Martaban hills, east of Tounghoo, at about 5000 ft. elevation.

CELASTRINEÆ.

Conspectus of species.

Subord. I. Celastraceæ. Stamens inserted outside the disk. Seeds albuminous.

* Capsule or follicle dehiscent.

× Ovules from the axis of the cells. Leaves opposite.

Evonymus. Petals free. Disk fleshy, broad; capsules 3—5-lobed and -celled.

Microtropis. Petals united at the base. Disk none or annular. Capsule 1-celled, 2-valved.

× × Ovules erect. Leaves alternate.

Celastrus. Ovary free. Capsules 2—4-celled, loculicidal. Seeds arillate. Flowers in panicles or racemes.

Gymnosporia. Ovary confluent with the disk. Capsule 2—3-lobed and -celled. Arillus complete, incomplete or wanting. Flowers in cymes.

KURRIMIA. Ovary free, styles 2. Capsule entire or 2-lobed, 1—2-celled, follicle-like and slowly dehiscing into 1 or 2 valves. Flowers in cymes or racemes, or panicled.

* * Fruit an indehiscent drupe or berry.

ELÆODENDRON. Ovary superior, confluent with the disk; drupe containing an 1—3-celled putamen. Leaves opposite or nearly so.

SIPHONODON. Ovary half-inferior, 5-celled. Berry large, containing many pyrenes. Leaves alternate.

Subord. II. HIPPOCRATEACEÆ. Stamens 3, rarely 2—5, inserted within or on the disk. Albumen none. Leaves opposite.

* Fruit an indehiscent berry, 1—many-seeded. Seeds not winged.

SALACIA. Only genus. Scandent shrubs. Inflorescences axillary. Stamens 3, rarely 2 or 4, inserted within the disk.

* * Fruit capsular or samaroid, dehiscent. Seeds winged.

× Ripe carpels samaroid, 2-valved. Stamens 3, inserted within the disk. Scandent shrubs.

HIPPOCRATEA. Ripe carpels usually 3. Seeds usually winged at the lower end. Inflorescences terminal or terminal and axillary.

× × Fruit a capsule. Erect trees or shrubs. Stamens 5, inserted on the disk.

LOPHOPETALUM. Capsule 3—4-celled and -lobed, loculicidal. Seeds winged all round. Not gland-dotted.

KOKOONA. Capsule 3-celled and -lobed, loculicidal. Seed winged at the upper end only. All herbaceous parts gland-dotted.

Evonymus, L.

Conspectus of species.

Subg. 1. EVONYMUS. Ovules 2 in each cell.

* Flowers solitary or clustered in the axils of the leaves.

Flowers nearly 5—6 lin. across; petals fringed; capsules sharply angular, on $\frac{1}{2}$—1 in. long peduncles; leaves glossy, entire, ... *E. Javanicus.*

Capsules globular, obtusely lobed, very shortly peduncled or almost sessile; leaves green, opaque, ... *E. calocarpus.*

* * Flowers in dichotomous cymes.

× Branchlets terete or nearly so, or somewhat compressed.

Flowers small, usually 5-merous; petals entire; capsules angular; leaves serrulate upwards, ... *E. glaber.*

× × Branchlets sharply 4-cornered or almost winged.

Flowers small, in very slender cymes; capsules small, smooth, ... *E. Griffithii.*

Subg. 2. GLYPTOPETALUM. Ovules solitary in the cells.

Bark red; petals 4, greenish purple, concave-orbicular, without grooves; capsules very rough from scurfy fissures and warts, ... *E. sclerocarpus.*

1. E. JAVANICUS, Bl. Bydr. 1146; Benn. in Horsf. Pl. Jav. var. 130. t. 28; Hf. Ind. Fl. I. 607.—(*E. Bancanus*, Miq. Suppl. Fl. Sum. 513).

HAB. Tropical forests of Tenasserim, from Moulmein southwards.—Fl. March.

2. E. CALOCARPUS, Kurz in Journ. As. Soc. Beng. 1872. 299; Hf. Ind. Fl. I. 609.

HAB. Tenasserim (Helfer 1973).

3. E. GLABER, Roxb. Fl. Ind. I. 628; Hf. Ind. Fl. I. 609.—(*E. garcinioides*, Roxb. HBC.; *E. Timorensis*, Laws. in Hf. Ind. Fl. I. 610, non Zipp.).

HAB. Not unfrequent in the tropical forests of Martaban and Tenasserim, rare in those of the eastern slopes of the Pegu Yomah; also Chittagong.—Fl. March, Apr.

4. E. GRIFFITHII, Kurz in Journ. As. Soc. Beng. 1872. 73; Ind. Fl. I. 611.—(*Hippocratea angulata*, Griff. Not. Dicot. 473. t. 581. f. 1).

VAR. α. GENUINA, petioles thick, hardly ¼ lin. long or the leaves almost sessile and obsoletely serrate.

VAR. β. DUBIA, petioles slender, 2—3 lin. long; leaves entire or nearly so.

HAB. Var. α. Ava, on rocks at Loonkarim and Delvi Nempean on the North from Assam (Griff. 1977); var. β. not unfrequent in the damp hill-forests of the Nattoung ranges in Martaban, east of Toungoo, at 6000—7000 ft. elevation.—Fl. Apr.?

VAR. β. will prove a distinct species, but as my specimens are in very young bud only, I am unwilling to establish the species until better material comes to hand.

5. E. SCLEROCARPUS, Kurz in Journ. As. Soc. Beng. 1872. 299.—(*Glyptopetalum sclerocarpum*, Laws. in Hf. Ind, Fl. I. 613).

HAB. Rather rare in the tropical forests around the Kambala toung of the central Pegu Yomah.—Fl. Fr. Febr.

Microtropis, Wall.

Conspectus of species.

× Cymes not much longer than the petiole, robust and crowdedly-flowered.
Leaves coriaceous, smooth; capsules ½ in. long, grey, ... *M. garcinifolia.*

× × Cymes much longer than the petiole, lax and dichotomously branched.
Leaves smooth, glossy above; peduncle slender, 1—1½ in. long, ... *M. bivalvis.*
Leaves coriaceous, wrinkled especially above, opaque; peduncle ½—¾ in. long, .. *M. longifolia.*

1. M. GARCINIFOLIA, Wall. ap. Wight Icon. t. 761.—(*Evonymus garcinifolius*, Roxb. Fl. Ind. I. 628; *M. discolor*, Wall. Cat. 4337: Hf. Ind. Fl. I. 614).

HAB. Rather frequent in the damp hill-forests of Martaban and Tenasserim, at 5000 to 7000 ft. elevation.—Fl. March.

2. M. BIVALVIS, Wall Cat. 4340; Hf. Ind. Fl. I. 614.—(*Celastrus bivalvis*, Jack.; Roxb. Fl. Ind. ed. 1. II. 399).

HAB. Tropical forests of Tenasserim, from Moulmein southwards.—Fl. Febr. and Sept.; Fr. Octob.

3. M. LONGIFOLIA, Wall. in Journ. As. Soc. Beng. 1873. 65.

HAB. Tenasserim, from Moulmein District (Dr. Brandis) down to Tavoy (Wall).—Fr. Octob.

The specimens in Brandis' herbarium have smaller and more obtuse leaves.

Celastrus, L.

Conspectus of species.

Panicles slender, terminal; capsules 3-celled with 3—6 seeds, ... *C. paniculatus.*
Cymes robust, forming usually axillary and terminal spurious panicles; capsule 1-celled and 1-seeded,.. *C. monosperma.*

1. C. PANICULATA, Willd. sp. pl. I. 1125; Roxb. Fl. Ind. I. 621; Wight Ill. t. 72 and Icon. t. 158; Hf. Ind. Fl. I. 617.—(*C. multiflora*, Roxb. Fl. Ind. I. 622; *C. nutans*, Roxb. l. c. 623).

VAR. *α.* GENUINA, all parts quite glabrous or nearly so.

VAR. *β.* PUBESCENS, (*C. pubescens*, Wall. Cat. 4303), leaves beneath and the petioles pubescent; panicles densely puberulous.

HAB. Not unfrequent in the leaf-shedding forests all over Pegu, especially in the drier parts; var. *β.* Pegu, Prome hills.—Fl. HS.; Fr. Sept. Octob.

2. C. MONOSPERMA, Roxb. Fl. Ind. I. 625; Hf. Ind. Fl. I. 618.

HAB. Ava, Khakhyen hills, Ponsee (J. Anderson).—Fr. March.

Lawson doubtfully gives Pegu as a locality for *C. stylosa*, Wall., but this is very probably a mistake.

Gymnosporia, WA.

Conspectus of species.

Unarmed; leaves oblong-lanceolate to lanceolate, finely acuminate,...... *G. acuminata.*
Unarmed; leaves obversely lanceolate, ... *G. oblanceolata.*
Armed, the spines leaf- and flower-bearing; leaves obovate, blunt to almost notched, .. *G. montana.*

1. G. ACUMINATA, Hf. Ind. Fl. I. 619.

HAB. Ava, Khakhyen hills.—Fl. Apr.

2. G. OBLANCEOLATA, Laws. in Hf. Ind. Fl. I. 619.

HAB. Burmah (Griff.) *teste* Lawson.

Barely recognisable by the meagre description given.

3. G. MONTANA, Laws. in Hf. Ind. Fl. I. 621 excl. syn. Lamk.—(*Celastrus montanus*, Roxb. Fl. Ind. I. 620; Wight Icon. t. 382).

HAB. Pegu, without locality (Dr. Brandis), probably Prome.?

Kurrimia, Wall.

1. K. ROBUSTA, Kurz in Journ. As. Soc. Beng. 1870. 73. (*Celastrus robustus*, Roxb. Fl. Ind. I. 626; *K. pulcherrima*, Wall. Cat. 4334, *nomen nudum*; Hf. Ind. Fl. I. 622).

Hab. Rare in the tropical forests along the eastern slopes of the Pegu Yomah, but frequent in those of Martaban and Tenasserim; also Chittagong.—Fl. Febr.; Fr. Apr. Aug.

Siphonodon, Griff.

1. S. celastrinus, Griff. in Macl. Calc. Journ. IV. 247. t. 14; Hf. in Linn. Trans. XXII. t. 26; Hf. Ind. Fl. I. 629.

Hab. Frequent in the tropical forests of the eastern slopes of the Pegu Yomah and of Martaban.—Fl. Jan. to May.

Salacia, L.

Conspectus of species.

* *Cymes peduncled and dichotomously branched, usually short.*

Branches terete; pedicels thick, 6—8 lin. long; sepals not ciliate; filaments very short, complanate and reflexed, ... *S. longifolia.*

Cymes 4 in. long! divaricate, ... *S. Griffithii.*

Branches marked by decurrent lines and more or less angular; pedicels about 4 lin. long, slender, arising from the globose rusty-bracteoled ends of the cyme-branches; sepals fringed; filaments nearly ½ lin. long, terete and erect, ... *S. tortuosa.*

* * *Flowers springing from an axillary sessile tubercle or wart.*

× Flowers large; petals about 3—4 lin. long.

Pedicels 2—3 lin. thick; leaves large, coriaceous, ... *S. grandiflora.*

× × Flowers minute or small, the petals less than 2 lines long.

† Leaves turning brown or dark-coloured in drying. Filaments very short and complanate.

Branchlets dark-brown, corky-lenticellate; leaves entire; sepals ciliate; ovary cells 2-ovuled, ... *S. verrucosa.*

Branchlets pale-coloured, sparingly lenticellate; leaves serrate; berries as large as a crab-apple, 2—3-seeded; sepals not ciliate, ... *S. Roxburghii.*

† † Leaves turning yellowish or pale green in drying.

O Petals clawed; filaments terete, slender.

Petals about a line long, clawed; pedicels as long or longer than the petiole; berries 1-seeded, ... *S. prinoides.*

O O Petals sessile; filaments very short and dilated.

Pedicels few, short, 1—1½ lin. long, ... *S. flavescens.*

Pedicels numerous, slender, longer than the petiole, ... *S. multiflora.*

1. S. longifolia, Wall. Pl. As. rar. III. 1832. 47. t. 278, non Hf. cujus homonymum in *S. Maingayanam* est mutandum.—(*S. floribunda*, Wight Ill. 1840. I. 134; Hf. Ind. Fl. I. 629).

Hab. Tenasserim, Mergui (Griff. 885/1); Moulmein District (Falconer).—Fr. Jan.

N. B.—Lawson has a *S. Griffithii* (Hf. Ind. Fl. I. 628) to which he ascribes divaricate cymes 4 in. long, but his brief phrase does not enable me to form an idea of the plant. Can it be *S. diandra*, Miq.?

2. S. tortuosa, Griff. Not. Dicot. 471. t. 581. f. 2.

HAB. Tenasserim, from Moulmein District down to Mergui (Griff. 899).—Fl. Jan. to March.

3. S. GRANDIFLORA, Kurz in Journ. As. Soc. Beng. 1872. 300; Hf. Ind. Fl. I. 626.

HAB. Tenasserim (Helf. 898).

4. S. VERRUCOSA, Wight Ill. I. 1840. 134; Hf. Ind. Fl. I. 628.—(*S. polyantha*, Korth. Verh. Natuurk. Gesch. Bot. 1839—42. 182; S. sp. Griff. Not. Dicot. 471).

HAB. Frequent in the tropical forests, from Martaban, east of Tounghoo, down to Tenasserim as far as Mergui (Griff. 888).—Fl. Jan. to March; Fr. Apr.

5. S. ROXBURGHII, Wall. Cat. 4217; Hf. Ind. Fl. I. 627.—(*Johnia salacioides*, Roxb. Fl. Ind. I. 168; *S. membranacea*, Laws. in Hf. Ind. Fl. I. 627).

HAB. Tropical forests of Tenasserim (Helf. 896).

Lawson gives Mergui, Moulmein, and the Andamans as localities for *S. viminea*, Wall. Cat. 7267, while he omits Penang and Malacca (Griff. 900), the original localities. Without seeing Burmese specimens I hesitate to adopt the species as Burmese.

7. S. PRINOIDES, DC. Prod. I. 571; Griff. Not. Dicot. 470; Wight Icon. t. 321; Hf. Ind. Fl. I. 626.—(*Johnia Coromandeliana*, Roxb. Fl. Ind. I. 169; *S. latifolia*, Wall. Cat. 4222; Hf. Ind. Fl. I. 629. pp.)

HAB. Frequent in the tidal forests, all along the coast, from Chittagong and Pegu down to Tenasserim and the Andamans.—Fl. Jan.; Fr. March to June.

This is one of those species that grow under the influence of the sea as well as in the interior of India, where it recurs in the stony drier tracts.

8. S. FLAVESCENS, Kurz in Journ. As. Soc. Beng. 1872. 300; Hf. Ind. Fl. I. 625.

HAB. Tenasserim (Helf. 897); Tavoy.

9. S. MULTIFLORA, Wight Ill. I. 134; Hf. Ind. Fl. I. 627.—(*S. myrtifolia*, Griff. Not Dicot. 470 ?)

HAB. Tenasserim, Mergui (Griff.).

I have not seen this species.

Hippocratea, L.

Conspectus of species.

× Petals $\frac{1}{2}$—1 lin. long, imbricated in the bud.

Petals about $\frac{1}{2}$ lin. long; leaves glaucous, ... *H. Indica.*

Petals about a line long; leaves turning brown in drying, ... *H. fuscescens.*

× × Petals about 2 lin. long, valvate in the bud.

Flowers outside and inflorescence greyish puberous; carpels linear-oblong, 2—3$\frac{1}{2}$ in. long, ... *H. macrantha.*

Petals inside densely greyish hairy, ... *H. Lobbii.*

1. H. Indica, Willd. sp. pl. I. 193; Roxb. Corom. Pl. II. t. 130 and Fl. Ind. I. 165; Hf. Ind. Fl. I. 624.

Hab. Rather rare in the open forests of Martaban, east of Toungboo; Tenasserim.—Fl. Apr.

2. H. fuscescens, Kurz in Journ. As. Soc. Beng. 1872. 300.

Hab. Upper Tenasserim, near Moulmein (Falconer).

3. H. macrantha, Korth. Verh. Natuurk. Gesch. Bot. 187. t. 39; Miq. Fl. Ind. Bat. I/2. 599 and Ann. Mus. Lugd. Bat. IV. 153.—(*H. grandiflora*, Wall. Cat. 4213).

Hab. Tenasserim (Helf. 905).

The disk both in the Tenasserim and the Khási hill plant is quite glabrous. The species differs from *H. obtusifolia* greatly in the size and shape of the ripe carpels.

4. H. Lobbii, Laws. in Hf. Ind. Fl. I. 624.

Hab. Tenasserim, Moulmain (*teste* Lawson).

Lophopetalum, Wight.

Conspectus of species.

* *Petals fringedly crested or lamellate on the upperside. Disk 5-lobed.*

Flowers nearly ½ in. in diameter; crest of petals fringed, ... *L. fimbriatum.*

* * *Petals naked, in a dried state often turning wrinkled or corrugate on the inner face.*

× Panicles glabrous. Disk smooth, in a dried state often conspicuously wrinkled. Leaves elliptical to ovate.

Panicles brachiate, stiff and squarrose; flowers about 3 lin. in diameter; disk wrinkled, ..*L. Wallichii.*

As preceding but panicles larger and slenderly branched; flowers about 2 lin. across; disk wrinkled, ... *L. littorale.*

Apparently the same as the preceding, but the disk said to be entirely covered with "lobulate warts," .... *L. celastroides.*

× × Panicles while young covered with a rusty coloured or greyish tomentum.

Leaves lanceolate to oblong-lanceolate; petiole 3—4 lin. long; flowers about 1—1½ lin. across; disk smooth or nearly so, ... *L. floribundum.*

1. L. fimbriatum, Wight Ill. I. 178; Hf. Ind. Fl. I. 615.

Hab. Lower Pegu, Poungleen (Dr. Brandis), and Martaban (Yoonzeleen, &c.) down to Tenasserim, Mergui (Griff.).—Fl. March.

2. L. Wallichii, Kurz in Journ. As. Soc. Beng. 1872. 299; Hf. Ind. Fl. I. 615.

Hab. Common in the open, more especially in the eng-forests, all over Pegu and Martaban down to Tenasserim.—Fl. Jan. March; Fr. March, Apr.

3. L. littorale, (*Kokoona littoralis*, Laws. in Hf. Ind. Fl. I. 617).

Hab. In inundated low lands of the Pazwoondoung river of Pegu;

in Upper Tenasserim apparently frequent.—Fl. Febr. March; Fr. March, Apr.

Very close to the preceding, but differing by its smaller flowers and in the slenderness of the peduncles and pedicels, as also in its growth in lowlands inundated during rains. Lawson ascribes sublamellate petals to this species, while they are simply longitudinally corrugate in the Burmese specimens, and hence I suspect that he has made up his phrasule (for a description it cannot be called) from Malayan specimens, quite overlooking the fact that Wallich's No. 6520 all came from Burma. He also still ascribes to the genus *Lophopetalum* "rarely winged, arillate seeds" and a "fleshy albumen," all characters which are applicable to the genus if taken in the absolute negative. Wight erroneously included the *Evonymus grandiflorus* in *Lophopetalum* and drew the characters of the seeds from it: whence the confusion which I have already pointed out in Journ. As. Soc. Beng. 1870, p. 73. On account of the dotted vegetative parts and the seeds being winged at the upper end only, I now prefer keeping up the genus *Kokoona* Thw. Lawson has also a *L. celastroides* from Upper Tenasserim and Pegu, the description of which does not enlighten one much as to the characters wherein it differs from the above otherwise than by the lobulate warts of the dried disk.

4. L. FLORIBUNDUM, Wight Ill. I. 178; Hf. Ind. Fl. I. 616.—(*Hippocratea pentandra*, Griff. Not. Dicot. 472).

HAB. Tenasserim, Mergui, in dense forests and along the coast of the island Madamaca (Griff. 1977/2).—Fl. Decb.

Doubtful species.

1. L. FILIFORME, Laws. in Hf. Ind. Fl. I. 616.

HAB. Tenasserim, Mergui (Griff.) *teste* Lawson.

Not seen by me, but hardly belongs to this genus. The cupular disk points to *Hippocratea*, but the number of stamens is not given.

RHAMNACEÆ.

Conspectus of genera.

Trib. I. ZIZYPHEÆ. Drupe containing a solid 1—3-celled putamen, or the fruit a capsule or indehiscent nut. Ovary superior or half-superior. Disk filling the calyx-tube.

* Ovary half-superior or superior. Fruit a nut, dry, coriaceous, 1-celled and 1-seeded, or a capsule. (*Ventilagineæ*).

VENTILAGO. Nut produced into a long terminal wing, indehiscent.

SMYTHEA. Capsule lanceolate or urn-shaped, 2-valved.

* * Ovary superior. Drupe fleshy or dry, with an 1—3-celled hard putamen. (*Zizypheæ genuinæ*).

ZIZYPHUS. Leaves palmately 3—5-nerved.

BERCHEMIA. Leaves penninerved.

Trib. II. RHAMNEÆ. Fruit dry or drupaceous, containing 3 (rarely 2—4) indehiscent or 2-valved cocci. Ovary superior to inferior.

* Ovary superior or half-superior. Drupe fleshy or dry, superior. Disk fleshy, filling the calyx-tube. (*Rhamneæ veræ*).

SAGERETIA. Flowers in terminal panicles. Leaves opposite or nearly so.

SCUTIA. Flowers in fascicles or umbellets. Leaves opposite or nearly so.

COLUBRINA. Flowers in cymes. Leaves alternate.

* * Ovary and fruit inferior, the latter crowned by the calyx-limb. (*Gouanieæ*).

APTERON. Styles 2. Fruit globose, not winged. Flowers clustered, in terminal panicles.

GOUANIA. Fruit dry, 3-cornered or -winged. Flowers spicate or racemose, panicled.

Ventilago, Gærtn.

Conspectus of species.

× Calyx adnate to the drupe, small and basilar.

Flowers in slender simple or branched racemes; not indistinctly puberous, the wing only 1—1½ in. long. .... *V. Madraspatana.*

× × Calyx adnate to the drupe for ⅓—½ of its length, and forming there a prominent ring.

O Flowers and fruit more or less yellowish pubescent or tomentose.

Racemose panicles and flowers tomentose; fruits puberulous, the wing 1½—1 in. long, the calyx reaching the middle of the nut, ... *V. calyculata.*

O O Fruits quite glabrous, even when young.

All parts glabrous; nuts about 3 lin. in diameter, the calyx reaching the middle and forming a sharp ring there, the wing rounded at the apex, ... *V. leiocarpa.*

Glabrous? ; nuts nearly ½ in. across, the calyx broad and flat, occupying only the basal part of the nut, the wing shortly acuminate, ... *V. Maingayi.*

1. V. MADRASPATANA, Gaertn Fruct. I. 223. t. 29 ; Wight Icon. t. 514 ; Bth. in Linn. Proc. v. 76 ; Hf. Ind. Fl. I. 631.

HAB. Tenasserim, Moulmein to Mergui (Griff. etc.) *teste* Bth.

2. V. CALYCULATA, Tul. in Ann. d. sc. nat. 4 ser. VIII. 124 ; Bth. in Linn. Proc. V. 76 ; Hf. Ind. Fl. I. 631, excl. syn. *V. macrantha.*—(*Ventilago Maderaspatana*, Roxb. Corom. Pl. I. 55. t. 76 and Fl. Ind. I. 629, non Gaertn.).

HAB. Not unfrequent in the open, especially the eng-forests, and in the dry forests of Prome, Pegu, and Martaban ; also Ava ; Tenasserim, *teste* Lawson.—Fl. Nov. ; Fr. March, Apr.

3. V. LEIOCARPA, Bth. in Linn. Proc. V. 77 ; Hf. Ind. Fl. I. 631.

HAB. Tenasserim.

4. V. MAINGAYI, Laws. in Hf. Ind. Fl. I. 631. (*V.* sp. Griff. Not. Dicot. 492).

HAB. Tenasserim (Helf.) ; Mergui (Griff.) *teste* Lawson.

Smythea, Seem.

1. S. CALPICARPA, Kurz in Journ. As. Soc. Beng. 1872. 301; Hf. in Ind. Fl. I. 632.

HAB. Tenasserim (Helf. 2026/1).

Zizyphus, Juss.

Conspectus of species.

* Flowers in axillary cymes or clusters.

O Leaves more or less tomentose or pubescent beneath. Drupes sappy, quite glabrous.

Leaves coriaceous, densely fulvous or whitish tomentose beneath, glabrous above; drupe $\frac{1}{2}$—$\frac{3}{4}$ in. long, the putamen 2-celled; erect shrub or tree, ... *Z. jujuba.*

Leaves membranous, above thinly beneath densely silky pubescent; drupe the size of a pea, the putamen 1- rarely 2-celled; erect or scandent shrub, ... *Z. oenoplia.*

O O Leaves glabrous or sprinkled with a few hairs on the nerves beneath.

Leaves green, thin chartaceous; drupes while young tawny tomentose, adult woody, .. *Z. glabra.*

* * Cymes collected into leafy or leafless panicles. Drupes woody.

Leaves glabrous, rigidly chartaceous; drupes glabrous; climber, ... *Z. funiculosa.*

Leaves densely fulvous tomentose or pubescent beneath; drupes glabrous; leaf-shedding tree, ... *Z. rugosa.*

1. Z. JUJUBA, Lamk. Exc. Meth. III. 318; Wight Icon. t. 99; Roxb. Fl. Ind. I. 608; Griff. Not. Dicot. 491; Edgew. in Linn. Proc. VI. 201; Hook. Journ. Bot. I. t. 140; Bedd. Fl. Sylv. Madr. t. 149; Brand. For. Fl. 86. t. 17; Hf. Ind. Fl. I. 632.

HAB. Common in the leaf-shedding, especially the dry and savannah-forests, of Prome and Ava, less frequent in those of the other provinces; also frequently cultivated in and around villages.—Fl. Aug., Sept.; Fr. Octob. to Jan.

2. Z. OENOPLIA, Mill. Dict. No. 3; Roxb. Fl. Ind. I. 611; Hf. Ind. Fl. I. 634, excl. syn. *Z. albens*, Roxb.—(*Z. Napeca*, Roxb. Fl. Ind. I. 613, non L.).

VAR. α. GLABRESCENS, leaves green on both sides, shortly and thinly pubescent. Usually a straggling shrub.

VAR. β. FERRUGINESCENS, leaves tawny villous beneath; usually a lofty climber.

VAR. γ. PEDICELLARIS (*Z. pedicellaris*, Wall. Cat. 4243), as preceding, but cymes longer peduncled and larger, pedicels about 3 lin. long.

HAB. Common all over Burma and the adjacent islands, as well in the leaf-shedding as in the evergreen forests; var. β. is a more southern form, frequent in Martaban, Tenasserim, the Andamans, etc.; var. γ. in Prome.—Fl. Sept. Octob.; Fr. C. S.

3. Z. GLABRA, Roxb. Fl. Ind. I. 614.—(*Z. Horsfieldii*, Miq. Fl. Ind. Bat. I. 643; *Z. venulosa*, Wall. Cat. 4235).

HAB. Frequent in the tropical forests, all over Burmah, from Ava and Chittagong down to Tenasserim and the Andamans.—Fr. C. S.

Prof. Lawson has created not a little confusion as regards this species. Without taking the trouble of studying Roxburgh's description, he based his identification upon Wallich's No. 4242 (doubtfully marked as *Z. glabra*), which is probably a glabrescent form of *Z. rugosa* and has nothing whatever to do with Roxburgh's plant. At the same time he makes quite a mélange of *Z. funiculosa*, to which hè refers not only the true *Z. glabra*, but also, apparently, *Z. subquinquenervia*, Miq., from Malacca (Maingay No. 412, a variety with smaller glabrescent drupes),—both species at once distinguishable from it by the axillary cymes.

4. Z. FUNICULOSA, Ham. in Wall. Cat. 4234; Hf. Ind. Fl. I. 636 pp.

HAB. Ava, Khakhyen hills.

5. Z. RUGOSA, Lamk. Enc. Meth. III. 319; Wight Icon. t. 339; Hf. Ind. Fl. I. 636 pp. (*Z. latifolia*, Roxb. Fl. Ind. I. 607).

HAB. Frequent in all leaf-shedding forests, more especially in the open ones, all over Burmah, from Ava and Martaban down to Tenasserim. Fl. March, Apr.; Fr. May.

Doubtful species.

1. Z. TOMENTOSA, Roxb. Fl. Ind. I. 611.

HAB. Chittagong, where it is used for fences.

Berchemia, Neck.

Conspectus of species.

Leaves 2—4 in. long, the petiole $\frac{3}{4}$—1 in. long; panicle ample, terminal, . . *B. floribunda.*
Leaves 1—$1\frac{1}{2}$ in. long, the petiole about 3 lin. long; racemes axillary, ... *B. polyphylla.*

1. B. FLORIBUNDA, Wall. Cat. 4256; Hf. Ind. Fl. I. 637.—(*Zizyphus floribunda*, Wall. in Roxb. Fl. Ind. II. 368).

HAB. Ava, Khakhyen hills (J. Anderson).

2. B. POLYPHYLLA, Wall. Cat. 4259; Hf. Ind. Fl. I. 638.

HAB. Ava, Taong dong (*teste* Lawson).

Sageretia, Brong.

1. S. THEEZANS, Brongn. in Ann. d. sc. nat. 1 ser. X. 360; Hf. Ind. Fl. I. 641. VAR. β. DIOSPYRIFOLIA, Laws. in Hf. l. c. 462.

HAB. Ava.—Fl. Octob.

Scutia, Comm.

1. Sc. MYRTINA, (*Rhamnus myrtinus*, Burm. Fl. Ind. 1768. 60; *Rhamnus circumscissus*, L. f. Suppl. 1781. 152; Roxb. Fl. Ind. I. 603;

Scutia Indica, Brongn. in Ann. d. sc. nat. X. 368; Wight Ill. t. 73; Hf. Ind. Fl. I. 640; *Rhamnus lucidus*, Roxb. Fl. Ind. I. 605).

VAR. *α.* RETUSA, leaves retuse or blunt.

VAR. *β.* ACUTIFOLIA, leaves acute.

HAB. Var. *β.* Tenasserim, along the Attaran river.

Colubrina, L. C. Rich.

Conspectus of species.

Leaves and cymes glabrous, ... *C. Asiatica.*
Cymes and under surface of leaves pubescent, ... *C. pubescens.*

1. C. ASIATICA, Brongn. in Ann. d. sc. nat. 1 ser. X. 369; Wight Ill. t. 74; Hf. Ind. Fl. I. 642.—(*Ceanothus Asiaticus*, L. sp. pl. 284; Roxb. Fl. Ind. I. 615; *Rhamnus acuminatus*, Colebr. in Roxb. Fl. Ind. I. 615).

HAB. Frequent in the beach- and coast-forests along the sea-shore, from Arracan down to Tenasserim and the Andamans.—Fl. Febr.; Fr. March Apr.

2. C. PUBESCENS, Kurz in Journ. As. Soc. Beng. 1872. 301; Hf. Ind. Fl. I. 642.

HAB. Frequent in the open, especially the low forests, all over Pegu and Martaban; also entering the tropical forests.—Fl. March; Fr. Apr. May.

Apteron, Kurz.

1. A. LANCEOLATUM, Kurz in Journ. As. Soc. Beng. 1872. 301; Hf. Ind. Fl. I. 643.

HAB. Upper Tenasserim, Moulmein District (Brandis, Falconer).—Fl. Febr.

Gouania, L.

Conspectus of species.

Leaves glabrous or nearly so, crenate; racemes puberulous, glabrescent: disk glabrous, 5-horned: capsules glabrous, ... *G. leptostachya.*
Leaves velvety above, densely tawny or rusty pubescent beneath, entire; racemes rusty-tomentose; capsules puberulous, ... *G. Brandisii.*

1. G. LEPTOSTACHYA, DC. Prod. II. 40; Wight, Icon. t. 974; Griff. Not. Dicot. 493. t. 585. f. 2; Hf. Ind. Fl. 1. 643.—(*G. tiliæfolia*, Roxb. Corom. Pl. I. t. 98. and Fl. Ind. I. 632).

HAB. Frequent in the mixed forests and in shrubberies along streams and around villages, all over Burma down to Tenasserim.—Fl. Close of R. S. Fr. C. S.

2. G. BRANDISII, Hassk. in Flora 1871. 280, in adnot.—(*G. integrifolia*, Kurz in Journ. As. Soc. Beng. 1870. 49, *non* Lamk.).

Hab. Not unfrequent in the tropical forests of Martaban and Tenasserim.—Fr. Febr. March.

This species may eventually turn out to be only an entire-leaved form of *G. Javanica*, Miq., but the flowers are still unknown.

AMPELIDEÆ.

Conspectus of species.

Vitis. Stamens free. Ovary 2-celled, with 2 ovules in each cell. Tendril-bearing climbers.

Leea. Stamens and petals united with the disk. Ovary 3—6-celled, with a solitary ovule in each cell. Erect shrubs or trees, without tendrils.

Vitis, L.

Conspectus of species.

Subg. I. Vitis (sens. extens.). Inflorescences branched in the usual way, not dilated and confluent.

§ 1. *Flowers in leaf-opposed or axillary true cymes. Flowers usually 4-merous.* (Cissus.)

O Leaves compound, from simple and pedately 3—9 or more foliolate to digitate, or if simple-leaved jointed with the petiole (1—2-foliolate).

\+ Leaves pedately or pinnately foliolate, very rarely spuriously digitate.

† Style short, spreadingly 4-lobed, or the 4-lobed or 4-cleft stigma sessile.

* Style short, spreadingly 4-lobed at the apex. Flowers often unisexual.

Leaves 3-foliolate; berries $1\frac{1}{2}$ in. in diameter; seed obovoid, grooved on the back, the groove with a linear tubercle; stem very warty.................... *V. tuberculata.*

Hermaphrodite; leaves coriaceous, 3-foliolate, the leaflets very shortly petioluled, .. *V. assimilis.*

Flowers unisexual; leaves sappy membranous, 3-foliolate to pedately 5-foliolate; cymes short; seeds oblong, smooth,.. *V. oxyphylla.*

* * Stigma sessile, 4-lobed or cleft. Flowers often unisexual.

All parts, also the very short cyme, glabrous; leaves 3-foliolate, sappy herbaceous; pedicels short, cymulose; berries white, pea-shaped,.............. *V. angustifolia.*

Very much as the preceding, but cymes very slender and large, puberulous; seeds half-orbicular, broadly and shallowly furrowed above with a long blunt ridge in the furrow, the sides transversely rugate,.......................... *V. bracteolata.*

Glabrous or the petioles and cyme often puberulous; leaves pedate, or the upper ones often 3-foliolate, sappy coriaceous; berries white, the size of a cherry or smaller; seeds obovoid-oblong, rugulose, broadly and shallowly furrowed on the back, .. *V. lanceolaria.*

Glabrous; leaves pedate, herbaceous-fleshy; pedicels 2—3 lin. long, umbellulate; berries black, the size of a pea, ... *V. serrulata.*

Very much as the preceding, but young shoots and petioles rusty hirsute; leaves spuriously digitate, ... *V. obtecta.*

† † Style simple, entire.

* Leaves all 3-foliolate.

Glabrous; cymes leaf-opposed, glabrous; leaves glaucous beneath, ... *V. semicordata.*

All parts shortly puberulous rarely glabrous; cymes axillary or on axillary shoots, puberulous, ... *V. trifolia.*

* * Leaves pedate.

× Cymes leaf-opposed and spuriously axillary, *i. e.* the cyme terminating an axillary leafy or leafless shoot.

All parts densely puberulous or pubescent, ... *V. Teysmanni.*

All parts glabrous; leaves sparingly pubescent along the nerves beneath, .. *V. Japonica.*

× × Cymes truly axillary, long-peduncled.

Leaflets cuneate-obovate, rather blunt or acute, slightly pubescent along the nerves beneath; seeds triangular with sharp margins, muricate on the back, .. *V. tenuifolia.*

All parts pubescent to almost glabrous; leaflets finely acuminate; seeds hemispherical, smooth, ... *V. pedata.*

+ + Leaves truly digitate.

All parts puberulous; cymes axillary and terminal on axillary shoots; leaflets 1½—2 in. long; style simple, ... *V. auriculata.*

Leaves glabrous; leaflets 4—6 in. long, fleshy herbaceous; cymes puberulous; berries globose, style simple, bark red, ... *V. erythroclada.*

Leaves glabrous: leaflets 4—6 in. long, coriaceous; cymes almost sessile, very slenderly branched, puberulous; flowers minute, dioecious; stigma peltately 4-lobed, almost sessile; seeds curved-oblong, ... *V. campylocarpa.*

O O Leaves simple or very rarely (in *V. Anamallayana**) the uppermost ones 3-foliolate. Cymes leaf-opposite (except in *V. Wallichii*).

× Branches and branchlets cornered, sometimes almost winged and fleshy.

Branchlets very fleshy, 4-cornered, jointed; leaves small, fleshy, bluntish crenate; cymes simple, ... *V. quadrangularis.*

Branchlets bluntish 5-angular, thick and glossy; leaves remotely bristly toothed, long-petioled, ... *V. pentagona.*

Branchlets sharply 6-cornered; leaves bristly serrate, herbaceous; cymes compound, peduncled or sessile; seeds obliquely obovate, transversely wrinkled on the faces, .. *V. discolor.*

As preceding; leaves shorter petioled, while young appressed hairy on the nerves beneath; seeds smooth, obovate, ... *V. costata.*

× × Branches and branchlets terete or nearly so.

† Cymes axillary; branchlets angular?

Leaves slightly 3-lobed, glabrous, sappy membranous, large; seeds globose, smooth, .. *V. Wallichii.*

† † Cymes leaf-opposed.

Branchlets terete, whitish pruinous; all parts glabrous; seeds smooth, ... *V. repens.*

All parts, especially while young, rusty or tawny tomentose or pubescent, more or less

* This species is so near to *V. repens* that I should not wonder if it were to turn out to be only an abnormal state of it.

glabrescent; leaves sharply acuminate, never lobed; seeds obovate, shallowly lacunose, ... *V. adnata.*

All younger parts rusty tomentose or pubescent, glabrescent; leaves large, often somewhat 3-lobed, bluntish acuminate, deciduous; seeds obovate, smooth, .. *V. Linnæi.*

§ 2. *Inflorescence a modification of the tendrils, cymose-panicled, racemose or spiked, or more usually the one or both tendril-branches transformed into a panicle. Flowers 4- or more usually 5-merous.* (Eu-Vitis.)

* Flowers pedicelled, in loose or contracted panicles.

† Seeds 2—4 lin. long, shallowly grooved and more or less distinctly radiately furrowed on the back.

× Glabrous or nearly so.

Cymose panicles ample, glabrous, with or without tendrils; pedicels thick, nearly a line long; leaves 3—5-lobed, the lobes usually acute,.. .... *V. latifolia.*

× × All parts more or less woolly-tomentose.

Branchlets, peduncles and usually the petioles covered with a woolly tomentum intermixed with black spreading stiff hairs; leaves almost glabrous,........ *V. barbata.*

Branchlets, etc. woolly without black hairs; leaves lobed to palmately lobed; panicles usually tendril-bearing, short and rather compact; pedicels very short and thick, .. *V. tomentosa.*

† † Seeds about a line long, longitudinally furrowed on the back, almost smooth, glossy-black.

Branchlets, etc., woolly, without black hairs; leaves tawny woolly beneath, slightly lobed; panicles usually tendril-bearing, woolly, large and lax; pedicels very slender, $1\frac{1}{2}$ lin. long, ... *V. lanata.*

* * Flowers sessile, in spikes, the spikes forming elongate panicles.

Young parts thinly and fugaceously woolly; leaves pedately 5—7-foliolate, glabrous except on the nerves beneath; spikes in very slender panicles, ... *V. Helferi.*

Quite glabrous; leaves digitately foliolate, glaucous green; spikes puberulous, forming $1\frac{1}{2}$—2 ft. long stout panicles,................................ *V. polystachya.*

Subg. II. Pterisanthes, Bl. Rachis of inflorescence leafy expanded and fleshy-membranous, the flowers sessile, unisexual.

Glabrous; leaves simple; a very slender twiner,........................ *V. polita.*

1. V. tuberculata, Laws. in Hf. Ind. Fl. I. 656.

Hab. Pegu (*teste* Lawson).

I have not seen this species, and I suspect that it is only a large-fruited, 3-foliolate form of *V. lanceolaria.*

2. V. assimilis, Kurz in Journ. As. Soc. Beng. 1872. 302.—(*V. lanceolaria* var. 2, *assimilis*, Laws. in Hf. Ind. Fl. I. 660).

Hab. Not rare in the drier hill-forests of the Martaban hills, east of Tounghoo, at 3—4000 ft. elevation.—Fl. March.

3. V. oxyphylla, Wall. Cat. 6035.

Hab. Frequent in the tropical forests of the eastern slopes of the Pegu Yomah and the Martaban hills, east of Tounghoo.—Fl. March.

4. V. lanceolaria, Wall. ap. WA. Prod. I. 128: Wight Icon. t. 177; Hf. Ind. Fl. I. 660, excl. syn. *C. feminea;* Miq. Ann. Mus. Lugd.

Bat. I. 78.—(*Cissus lanceolaria,* Roxb. in Wall. Fl. Ind. I. 430; *V. muricata,* WA. Prod. I. 128; Wight Icon. t. 740).

VAR. α. LANCEOLARIA, cymes loose and ample, densely puberulous, the pedicels longer and slender: petioles and petiolules puberulous (*Cissus lanceolaria,* Roxb. l. c.; *V. Hookeri,* Laws. in Hf. Ind. Fl. I. 661 ?)

VAR. β. TUBERCULATA (*Cissus tuberculata,* Bl. Bydr. 189), cymes short and often somewhat compact, less puberulous or glabrous, the pedicels usually shorter and thicker; petioles, &c., all glabrous; berries and seeds usually smaller.

HAB. Both varieties, but more so var. β., common in the tropical forests all over Martaban down to Tenasserim and the Andamans; also along the eastern slopes of the Pegu Yomah; Chittagong.—Fl. Febr. March; Fr. Apr. May.

VAR. α. is in my opinion the true Roxburghian plant, while var. β. is Blume's *Cissus tuberculata.*

5. V. SERRULATA, Wall. ap. Miq. Ann. Mus. Lugd. Bat. I. 77. (*Cissus serrulata,* Roxb. Fl. Ind. 1820. I. 114; *Cissus capriolata,* Royle Ill. Him. Pl. t. 26; *V. capriolata,* Don. Prod. Nep. 188; Hf. Ind. Fl. I. 659).

VAR. α. CAPRIOLATA, all parts quite glabrous.

VAR. β. SUBOBTECTA, branches and petioles rusty-pubescent like those of *V. obtecta,* and forming a transition to it, the leaves partially becoming digitate.

HAB. Frequent along mountain-streams in the tropical forests of Martaban, up to 3000 ft. elevation; Ava, Khakhyen hills; Chittagong; var. β. Ava, Khakhyen hills.—Fr. Febr. March.

6. V. OBTECTA, Wall. Cat. 6026; Hf. Ind. Fl. 1. 657.

HAB. Ava, Khakhyen hills (J. Anderson).

7. V. SEMICORDATA, Wall. in Roxb. Fl. Ind. II. 1824. 481.—(*V. Himalayana,* Brand. For. Fl. 100; Hf. Ind. Fl. I. 655).

VAR. α. SEMICORDATA, Laws. in Hf. Ind. Fl. I. 656.—(*V. semicordata,* Wall. l. c.) young parts, inflorescence, and leaflets beneath, shortly and sparingly hairy.

VAR. β. HIMALAYANA, (*V. Himalayana,* Brand. l. c.; *V. Neilgherrensis,* Wight Icon. t. 965; *Ampelopsis Himalayana,* Royle Ill. Him. Pl. 149), all parts quite glabrous, leaflets glaucous beneath.

HAB. Var. β. in the drier hill-forests of the Martaban hills, east of Tounghoo, at about 3000 ft. elevation.—Fl. March.

8. V. TRIFOLIA, L. sp. pl. 293; Bth. Fl. Austr. I. 449.—(*Cissus carnosa,* Lamk. Dict. I. 31; Roxb. Fl. Ind. I. 409; *V. carnosa,* WA. Prod. I. 127; Wight Icon. t. 171; Hf. Ind. Fl. I. 654).

VAR. α. GENUINA, all parts shortly greyish pubescent.

VAR. *β.* GLABRATA, all parts glabrous or nearly so.

HAB. Rather frequent all over Burma, especially in rubbishy places, in hedges, and shrubberies, becoming a powerful climber in the forests.—Fl. R. S.

I follow Miquel in adopting Linné's oldest name, which is evidently given in allusion to the trefoil (*Trifolium*).

9. V. TEYSMANNI, Miq. in Ann. Mus. Lugd. Bat. I. 82.—(*Cissus Teysmanni*, Miq. Suppl. Fl. Sumatr. 516; *V. mollis*, Wall. Cat. 6025; Hf. Ind. Fl. I. 660).

HAB. Chittagong (*teste* Lawson).

10. V. JAPONICA, Thbg. Fl. Jap. 104.—(*Cissus Japonica*, DC. Prod. I. 632; *Cissus leucocarpa*, Bl. Bydr. 189; Miq. Fl. Ind. Bat. I/2. 663; *V. cymosa*, Roxb. in Wall. Cat. 6017).

HAB. Frequent along mountain-streams and on moist rocks in the tropical forests of the Pegu Yomah, and from Martaban down to Tenasserim; also Ava, Taongdong.—Fl. R. S.; Fr. Jan. Febr.

11. V. TENUIFOLIA, WA. Prod. I. 129; Hf. Ind. Fl. I. 660 in part.

HAB. In the mixed forests of the Pegu Yomah and Arracan; also in bamboo-jungles of the Andamans.—Fl. May, June.

Possibly only a more luxuriant form of the preceding species, with more obtuse leaflets and truly axillary cymes.

12. V. PEDATA, Wall. ap. WA. Prod. I. 128; Hf. Ind. Fl. I. 661. (*Cissus pedata*, Lamk. Dict. I. 31; Roxb. Fl. Ind. I. 413).

VAR. *α.* GENUINA, leaves pedately foliolate, pubescent.

VAR. *β.* GLABRATA, as preceding, but pretty glabrous.

HAB. Var. *α.* frequent in leaf-shedding forests and more especially in hedges and shrubberies of the cultivated alluvial plains; var. *β.* in tropical forests of the Andamans.—Fl. Begin of R. S.

13. V. AURICULATA, Wall. ap. WA. Prod. I. 129; Wight Icon. t. 145; Hf. Ind. Fl. I. 658.—(*Cissus auriculata*, Roxb. Fl. Ind. I. 411).

HAB. In the mixed forests of the Pegu Yomah; Chittagong.—Fl. Begin of R. S.

14. V. ERYTHROCLADA, Kurz in Journ. As. Soc. Beng. 2872. 301.

HAB. Not unfrequent in the tropical and other forests along streams of the Pegu Yomah and Martaban east of Tounghoo.—Fl. March.

Amongst the digitate species, this comes nearest to *V. saponaria*, Seem.

15. V. CAMPYLOCARPA, Kurz in Journ. As. Soc. Beng. 1872. 302; Hf. Ind. Fl. I. 657.—(*Cissus feminea*, Roxb. Fl. Ind. I. 410?; *Panax micranthum*, Wall. Cat. 4938).

HAB. In the tropical forests of the slopes on eastern face of Kambala toung, Pegu Yomah, at 1000—2000 ft. elevation; Ava, Taong Dong (Wall.)—Fl. Nov.; Fr. March.

Diœcious, remarkable for its minute flowers, and in this respect resembling *V. pubiflora*, Miq. (syn. *V. peduncularis*, Lawson). Lawson says that it has no tendrils, but in this he is mistaken. I believe it to be Roxburgh's *C. feminea*, but not having seen the female flowers, I hesitate to pronounce its identity with that species. Lawson confidently reduces *C. feminea* to a synonym of *V. lanceolaria*, but the digitate leaves alone forbid a comparison with it.

16. V. QUADRANGULARIS, Wall. ap. WA. Prod. I. 125; Wight Icon. t. 51; Hf. Ind. Fl. I. 645.—(*Cissus quadrangularis*, L. Mant. 39; Roxb. Fl. Ind. I. 407).

HAB. Frequent in wild shrubby and waste places and in the dry forests of the Prome district; also Ava.—Fl. Nov.

17. V. PENTAGONA, Voigt Cat. Hort. Calc. 28; Kurz in Journ. As. Soc. Beng. 1870. 74; Hf. Ind. Fl. I. 646.—(*Cissus pentagona*, Roxb. Fl. Ind. I. 408).

HAB. Not unfrequent in the tropical forests of the eastern slopes of the Pegu Yomah, and from Chittagong and Arracan down to the Andamans.—Fl. Octob.; Fr. Apr. May.

In Journ. As. Soc. *l. c.*, I stated that *Cissus hastata*, Miq. (= *V. hastata*, Miq. Ann. Mus. Lugd. Bat. 1863. I. 85., a species which Lawson 12 years later rechristens *V. sagittifolia*, Laws. in Hf. Ind. Fl. 1875. I. 645) was identical with *V. glaberrima*, Wall. This is an error, which arose from my having solely consulted the Wallichian specimens of *V. glaberrima*, which all happen to be *V. hastata*.

18. V. DISCOLOR, Dalz. in Hook. Kew. Misc. II. 39; Miq Ann. Mus. Lugd. Bat. I. 86; Hf. Ind. Fl. I. 647, excl. syn. *V. costata*.—(*Cissus discolor*, Bl. Bydr. 281; Bot. Mag. t. 4763; *Cissus velutinus*, Linden in Bot. Mag. t. 5207).

VAR. *α*. DISCOLOR, leaves usually spotted, purplish beneath, on very long petioles (at least the lower ones); cymes peduncled.

VAR. *β*. SESSILIS, Miq. in Ann. Mus. Lugd. Bat. I. 86, cymes sessile and umbelately branched already from the base.

HAB. Var. *α*. frequent in the tropical forests and moister bamboo-jungles, from Arracan, the Pegu Yomah, and Martaban down to Tenasserim and the Andamans; var. *β*. in the Martaban hills, east of Tounghoo.—Fl. R. S.; Fr. C. S.

19. V. COSTATA, Wall. Cat. 6011.

HAB. Not unfrequent in the open and the mixed forests of Pegu and Arracan; also Martaban.—Fr. H. S.

20. V. WALLICHII, Kurz in Journ. As. Soc. Beng. 1872. 302, *non* DC. (*Leea cordata*, Wall. Cat. 6819.)

HAB. Ava, Irrawaddi valley at Meaong.

Very near to *V. pallida*, WA., as Lawson has pointed out, but the axillary cymes distinguish it from that species.

21. V. REPENS, WA. Prod. I. 125; Hf. Ind. Fl. I. 646.—(*Cissus repens*, Lamk. Dict. I. 31; DC. Prod. I. 628; Rheed. Hort. Malab. VII. t. 48; *V. glauca*, WA. Prod. I. 126; *Cissus glauca*, Roxb. Fl. Ind. I. 406; DC. Prod. I. 628; *Cissus glauca*, Roxb. Fl. Ind. I. 406; *Cissus Blumeana*, Steud. Nomencl.; Miq. Fl. Ind. Bat. I/2. 605; *Cissus cerifera*, T. et B. in Natuurk. Tydsch. Ned. Ind. XXIV. 324).

HAB. Frequent as well in the tropical as in the moister mixed forests, all over Burma, from Chittagong and Ava down to Tenasserim and the Andamans.—Fl. R. S.; Fr. C. S.

22. V. ADNATA, Wall. ap. WA. Prod. I. 126; Wight Icon. t. 144; Hf. Ind. Fl. I. 649.—(*Cissus adnata*, Roxb. Fl. Ind. I. 405).

VAR. *α*. GLABRIOR, Miq. in Ann. Mus. Lugd. Bat. I. 87, all parts more glabrous, leaves only along the nerves beneath pubescent.

VAR. *β*. COMMUNIS, all parts more or less rusty tomentose; leaves above glabrous or puberulous, beneath wholly or only along the nerves tomentose.

HAB. Var. *α*. rarely in the hill-toungyas of the Martaban hills, at 3000—4000 ft. elevation; var. *β*. frequent in all leaf-shedding forests and in shrubberies and village-bushes, more especially along choungs, all over Burma and adjacent provinces.—Fl. Close of R. S.; Fr. H. S.

23. V. LINNÆI, Kurz, *non* Wall.*—(*Cissus vitiginea*, L. sp. pl. 117; Roxb. Fl. Ind. 1. 406; *V. repanda*, WA. Prod. I. 125; Hf. Ind. Fl. I. 648).

HAB. Frequent as well in the mixed and open forests as also in shrubberies and grass jungles, all over Burma and adjacent provinces down to Tenasserim.—Fl. H. S. and Close of R. S.; Fr. C. S.

Lawson identifies Roxburgh's *Cissus vitiginea* with *V. lanata*, but he has never formed a clear conception of the difference between the inflorescence of the *Vitis*-section and that of the *Cissus*-section: hence the error.

24. V. LATIFOLIA, Roxb. Fl. Ind. I. 661; WA. Prod. I. 130; Hf. Ind. Fl. I. 652.

HAB. Frequent in the savannahs and savannah jungles, also in shrubberies and village woods, but rather rare in the leaf-shedding forests, all over the Pegu plains, especially in the Sittang valley; also Andamans, in forests.—Fl. Apr. May.

N. B.—*V. vinifera*, L. is often seen cultivated by Europeans, and is said to bear good grapes in Ava.

* Whose name has to be changed into *Vitis angulata* (*Cissus angulata*, Lamk.). Mr. C. B. Clarke informs me, that my *Vitis spectabilis* is not a climber, but a perfectly erect perennial about 2 ft. high, nearly simple, without tendrils. It grows in the Sikkim Terai only.

25. V. BARBATA, Wall. in Roxb. Fl. Ind. II. 478; Hf. Ind. Fl. I. 651.

VAR. *α*. GENUINA, leaves only thinly lanate beneath, black hairs numerous and conspicuous.

VAR. *β*. JENKINSII, leaves entire or lobed, their undersurface as well as the stems densely tawny or rusty woolly-tomentose, black hairs very sparingly interspersed among the tomentum.

HAB. Frequent in the low and lower mixed forests, all over Ava and Martaban down to Tenasserim; var. *β*. Ava, Taong Dong (Wall. Cat. 5994 B.).—Fl. Apr. May.

26. V. TOMENTOSA, Heyne in Roth. Nov. sp. 157; DC. Prod. I. 634; WA. Prod. I. 130; Wight Ill. I. t. 57; Hf. Ind. Fl. I. 650.

HAB. In deserted toungyas of the Martaban hills, east of Toungloo, at 3—4000 ft. elevation.—Fl. Fr. March.

27. V. LANATA, Roxb. Fl. Ind. I. 660; WA. Prodr. I. 131; Hf. Ind. Fl. I. 651, excl. syn. *C. vitiginea*, Roxb.

HAB. Not unfrequent in deserted toungyas of Martaban and Tenasserim; also Ava and Chittagong.—Fl. Fr. Febr. March.

28. V. HELFERI, Laws. in Hf. Ind. Fl. I. 662.

HAB. Tenasserim (Helf. 1341).

29. V. POLYSTACHYA, Wall. Cat. 6028; Hf. Ind. Fl. I. 662.

HAB. Tenasserim or Andaman islands, *teste* Lawson.

30. V. POLITA, Miq. in Ann. Mus. Lugd. Bat. I. 95; Hf. Ind. Fl. I. 663.

HAB. Tenasserim, Moulmain (Lobb), *teste* Lawson.

Doubtful species.

1. *V. dubia*, Laws. in Hf. Ind. Fl. I. 661.

HAB. Chittagong? *teste* Lawson.

Not recognisable from the description alone, the more so as Lawson's arrangement, or I should rather call it disarrangement, of the species of *Vitis* is based upon purely technical and more or less variable characters, without reference to natural affinity. Should it really be *Vitis* No. 41 of Hf. and Th. Herb. Ind. orient., as I strongly suspect, it will be a pedately foliolate form of *V. oxyphylla*, Wall.

Leea, L.

Conspectus of species.

× Leaves ample, simple or rarely 3-foliolate.

Leaves simple, large, very glaucous and shortly puberulous beneath; lobes of the staminal tube entire; shrubby, ... *L. macrophylla.*

Leaves simple and pinnately 3-foliolate, hardly glaucescent but minutely puberulous beneath; lobes of the staminal tube notched; shrubby, ... *L. latifolia.*

× × Leaves from simply pinnate to decompound.

O All parts (except the inflorescence in a few species) glabrous.

† Inflorescence with persistent and conspicuous bracts and bractlets.

Slender treelet; flowers sessile or nearly so, crowded, greenish-white, . . *L. compactiflora.*

† † Bracts and bractlets minute, usually already dropped before the flower-buds are properly developed.

* Leaves coriaceous. Flowers greenish-white or green with a purplish hue.

Leaves more or less glaucous, usually linear or lanceolate; lobes of the staminal tube erect, notched; seeds smooth and rounded on the back; undershrub, . . *L. parallela.*

Leaves dark-green, glossy; lobes of staminal tube erect, notched; seeds even and convex on the back; a tree, ... *L. sambucina.*

Leaves dark-green, glossy; lobes of staminal tube reflexed, acuminate; seeds tubercled-keeled, the edges tubercled-ribbed; a large shrub, ... *L. gigantea.*

* * Leaves more or less membranous. Flowers red, orange, or scarlet.

Leaflets 6—8 in. long: inflorescence rusty-tomentose; undershrub, ... *L. læta.*

Leaflets only $2\frac{1}{2}$—4 in. long; inflorescence glabrous or nearly so, undershrub, *L. coccinea.*

O O More or less pubescent or stiff-hairy, at least the nerves beneath.

† Leaves usually simply pinnate.

Leaflets coarsely serrate, acute, roughish pubescent along the nerves beneath; nerves all parallel; petiolules thick and short; stems, petioles, and peduncles curled-winged; bracts and bractlets long, lanceolate-subulate; shrubby, ... *L. crispa.*

Dwarf, all parts robust and densely pubescent or almost tomentose; petioles and petiolules terete; cymes tomentose; bracts minute; undershrub, ... *L. pumila.*

† † Leaves usually 2- or 3-pinnate.

Leaflets coarsely serrate, acuminate, roughish pubescent on the parallel nerves beneath; stems and petioles terete or nearly so; peduncle compressed-cornered; bracts and bractlets small, linear-lanceolate; flowers greenish-white; shrubby, ... *L. aspera.*

All parts stiff-pubescent; leaflets membranous, stiffly pubescent, beneath densely gland-dotted; petioles, &c., all terete; cymes stiff, pubescent; bracts large, broadly ovate, blunt; undershrub, ... *L. æquata.*

Almost glabrous or greyish puberulous; leaves 2—3-pinnate; leaflets puberulous or glabrous, not gland-dotted beneath; bracts and bractlets none; shrubby, *L. robusta.*

Stems, petioles, &c., quite glabrous; leaflets small, sprinkled with white stiff hairs; bracts or bractlets none; undershrub, ... *L. rubra.*

1. L. MACROPHYLLA, Roxb. Fl. Ind. I. 653 (non DC.), Wight Icon. t. 1154? (*L. simplicifolia*, Griff. Not. Dicot. 697. t. 645. f. 1?)

VAR. *α.* GENUINA, leaves larger and broader, usually somewhat lobed, glaucous and puberulous beneath.

VAR. *β.* OXYPHYLLA, leaves ovate to ovate-oblong, acuminate, less glaucous beneath or one-coloured, glabrous.

HAB. Var. *β.* frequent in the mixed forests, especially the upper ones, of Pegu and Martaban.—Fr. C. S.

2. L. LATIFOLIA, Wall. Cat. 6821.

HAB. Prome hills.

3. L. PARALLELA, Wall. Cat. 6828; Hf. Ind. Fl. I. 666.

Var. α. genuina, leaves usually pinnate or occasionally bipinnate, leaflets oblong or oblong-lanceolate, more glaucous; calyx-lobes rotundate.

Var. β. angustifolia, (*L. angustifolia*, Laws. in Hf. Ind. Fl. I. 665), leaves usually 2—3-pinnate, leaflets narrow-linear to linear, very acuminate, calyx-lobes in fruit obtuse, but not rotundate.

Hab. Var. α. Ava, Irrawaddi valley; var. β. frequent in the mixed forests and grass jungles of Pegu, especially the Irrawaddi zone.—Fr. C. S.

4. L. sambucina, Willd. sp. pl. I. 1177; DC. Prod. I. 653; Roxb. Fl. Ind. I. 657; Griff. Not. Dicot. 598. t. 644. fig. 1; Rumph. Herb. Amb. IV. t. 45.—(*L. staphylea*, Roxb. Fl. Ind. I. 636; WA. Prod. I. 132; Wight Ill. t 58. and Icon. t. 78; *L. ottilis*, DC. Prod. I. 636).

Hab. Frequent in the tropical forests of the eastern slopes of the Pegu Yomah, Arracan, and Martaban down to Tenasserim and the Andamans. Fl. March; Fr. May.

Leea sambucina, of the 'Flora of India' (not of authors), is a mélange of species, which Lawson explains, *more Kewensi*, by saying that there are transitional conditions so numerous that the species reduced by him cannot be maintained.

5. L. gigantea, Griff. Not. Dicot. 697. t. 645. f. 3; Kurz in Journ. As. Soc. Beng. 1873. 65.

Hab. Tenasserim, from Moulmein down to Tavoy.—Fl. Aug. Octob.; Fr. Febr. March.

6. L. compactiflora, Kurz in Journ. As. Soc. Beng. 1873. 65.

Hab. Rather rare in the drier hill-forests of the Martaban hills, east of Tounghoo, at about 3000 ft. elevation.—Fl. Apr.

7. L. læta, Wall. Cat. 6831; Kurz in Journ. As. Soc. Beng. 1873. 65.

Hab. Ava (Wall.); frequent in the tropical forests of South Andaman.—Fl. June.

Very likely only a luxuriant form of the following species.

8. L. coccinea, Planch. in Hort. Donat. 6; Bot. Mag. t. 5299.

Hab. Not uncommon in the savannahs and savannah-forests of Pegu, rarely in the diluvial forests of Martaban.—Fl. May June; Fr. Jan.

9. L. crispa, L. Mant. 124; Roxb. Fl. Ind. I. 654; Hf. Ind. Fl. I. 665.—(*L. pinnata*, Andr. Bot. Repos. V. t. 355).

Hab. Frequent in the low and mixed forests of Pegu and Chittagong.

10. L. pumila, Kurz in Journ. As. Soc. Beng. 1872. 302; Hf. Ind. Fl. I. 666.

Hab. Not unfrequent in the eng and low forests of Pegu and Martaban.—Fl. probably May, June.

11. L. aspera, Wall. in Roxb. Fl. Ind. II. 468; Hf. Ind. Fl. I. 665.

Hab. Common in the mixed forests, especially in the upper ones, and in savannahs, all over Pegu.—Fr. Febr.

12. L. æquata, L. Mant. 124; Miq. in Ann. Mus. Lugd. Bat. I. 98.—(*L. hirta*, Hornem. Hort. Hafn. I. 231; Roxb. Fl. Ind. I. 656; Hf. Ind. Fl. I. 668).

Hab. Not unfrequent in the tropical forests of Martaban and Tenasserim, also Andamans.—Fl. June.

13. L. robusta, Roxb. Fl. Ind. I. 655, *non* Laws.—(*L. aspera*, Wall. Cat. 6825; *L. diffusa*, Laws. in Hf. Ind. Fl. I. 667).

Hab. Not unfrequent in savannahs and in open grassy places of the forests of Pegu and Arracan.—Fl. Octob.; Fr. C. S.

N. B.—*L. robusta*, Laws. *non* Roxb. = *L. Sundaica*, Miq.

14. L. rubra, Bl. Bydr. 197; Miq. Fl. Ind. Bat. I/2. 611 and Ann. Mus. Lugd. Bat. I. 96.

Hab. Tenasserim, Attaran (Dr. Brandis).

N. B.—*L. sanguinea*, Kurz in Journ. As. Soc. Beng. 1873. 66 (not of Wall.) is *L. alata*, Edg. It is not a Burmese species, and the locality Ava should be referred to *L. læta*.

SAPINDACEÆ.

A. Seeds with albumen. Stipules present.

Trib. I. STAPHYLEÆ. Flowers regular. Stamens inserted outside the disk. Leaves opposite.

Turpinia. Ovary 3-celled. Fruit entire, indehiscent. Leaves pinnate, or rarely simple.

B. Seeds without albumen. Stipules none.

a. Stamens inserted outside or on the disk. Flowers regular.

Trib. II. DODONÆÆ. Stamens inserted outside the disk. Capsule septicidally dehiscing. Leaves alternate.

Dodonæa. Sepals valvate. Petals none. Ovules by pairs. Leaves usually simple.

Trib. III. ACERINEÆ. Stamens inserted on the disk. Samaras indehiscent. Leaves opposite.

Acer. Petals none or present. Disk annular. Samaras 2. Leaves simple or palmately lobed.

b. Stamens inserted inside the disk, sometimes unilateral.

Trib. IV. SAPINDEÆ. Leaves alternate, or rarely (in *Æsculus*) opposite. Flowers regular or irregular.

* *Fruit or fruit-lobes indehiscent, drupaceous, fleshy or rarely corticate or crustaceous.*

× Fruit entire, 1—4-celled.

O No petals. Flowers polygamously diœcious.

Schleichera. Calyx small, valvate or nearly so. Disk unilateral. Seeds arillate. Leaves abruptly pinnate.

O O Petals present, furnished with scales. Flowers polygamously monœcious.

LEPISANTHES. Flowers regular. Disk regularly annular. Leaves pinnate.

HEMIGYROSA. Flowers irregular. Disk unilateral, cushion-like. Leaves pinnate.

× × Fruit divided deeply or to the base into 3—2 lobes, the lobes often solitary by abortion of the others.

O Flowers irregular. Arillus none.

† Leaves pinnate. Trees.

DITTELASMA. Fruit deeply 1—3-lobed, the lobes drupaceous, globose. Testa bony. Embryo curved. Disk half crescent-shaped.

ERIOGLOSSUM. Fruit to the base 1—3-lobed, the lobes oblong. Testa membranous. Embryo straight. Disk unilateral.

† † Leaves 3—1-foliolate. Shrubs or small trees.

ALLOPHYLUS. Flowers irregular or almost regular, with the place of the 5th petal empty. Sepals orbicular. Petals with scales. Fruit-lobes fleshy or sappy. Racemes simple or compound.

O O Flowers regular.

† Seeds without arillus.

SAPINDUS. Fruit-lobes deeply or to the base separated, by 2—3 or often solitary by abortion, the pericarp crustaceous or coriaceous, smooth. Testa crustaceous or membranous.

XEROSPERMUM. Fruit-lobes separated to the base, by pairs or solitary, the pericarp crustaceous, tubercled. Testa fleshy and pilose within, resembling an arillus.

† † Seeds truly arillate.

NEPHELIUM. Fruit-lobes 1—3, separated to the base, the pericarp coriaceous to crustaceous, smooth to variously tubercled, muricate, and echinate. Seeds entirely enveloped by the arillus.

POMETIA. Fruit-lobes 1—3, separated to the base, the pericarp corticate, smooth. Seeds arillate at the lower end. Hardly different from *Nephelium.*

* * *Fruit a dry dehiscent capsule, the valves from woody to coriaceous and membranous.*

O Ovules solitary in each cell.

× Trees or shrubs. Leaves pinnate. Capsule coriaceous or woody. Flowers regular.

† Petals cucullate, or the blade shorter than the cucullate scale.

SCYPHOPETALUM. Style obsolete. Petals cucullate, without scale.

PARANEPHELIUM. Petals broadly trigonous, smaller than the cucullate scales. Style long. Capsule 3-valved, woody, tubercled or aculeate-muricate. Leaves pinnate, the end-leaflets ternate.

† † Petals flat or nearly so, longer than the scale if present, or the petals minute or wanting altogether.

CUPANIA. Calyx cup-shaped or the sepals distinct. Capsule 3-quetrous or -lobed or didymous.

× × Twining tendril-bearing undershrubs. Leaves twice ternately foliolate. Capsule bladdery-membranous, inflated. Flowers irregular.

CARDIOSPERMUM. Sepals 4, the 2 outer ones small. Petals 4, with basal scales. Disk almost reduced to 2 round or linear glands opposite the lower smaller petals.

O O Ovules by 2 or more in each cell. Trees.

× Capsule membranous or chartaceous. Flowers regular, the sepals free. Leaves pinnate, alternate.

HARPULLIA. Petals without scales, but sometimes with inflexed lobes at the base of the blade. Stigma linear, often twisted. Capsule didymously 2-lobed, chartaceous, not winged. Seeds arillate.

ZOLLINGERIA. Petals with a woolly scale. Stigma 3-toothed. Capsule by maceration of the cell-walls often 1-celled, 3- or rarely 2-winged, chartaceous. Seeds without arillus.

× × Capsule thick or fleshy-coriaceous. Flowers irregular, the calyx tubular or bell-shaped. Leaves digitate, opposite.

ÆSCULUS. Flowers rather showy. Stigma simple.

Turpinia, Vent.

Conspectus of species.

Leaves apiculate to abruptly acuminate; flowers about 2 lin. across; fruits the size of a cherry, firmly fleshy, ... *T. pomifera.*

Leaves almost caudate; flowers minute, about a line across: fruits the size of a small pea, ... *T. montana.*

1. T. POMIFERA, DC. Prod. II. 3; Hf. Ind. I. 698 pp.—(*Dalrymplea pomifera*, Roxb. Corom. Pl. III. 276. t. 279. and Fl. Ind. I. 633; *T. sphærocarpa*, Hassk. Cat. Bog. 228; Miq. Fl. Ind. Bat. I/2. 593).

HAB. Frequent in the tropical forests of Pegu and still more so in those of Martaban and Tenasserim; also Chittagong.—Fl. Febr.; Fr. C. S.

2. T. MONTANA, (*Zanthoxylon montanum*, Bl. Bydr. 248; Miq. Fl. Ind. Bat. I/2. 670).

VAR. α. GENUINA, panicles very slender and lax, as long or longer than the leaves, the ultimate branchings almost filiform.

VAR. β. NEPALENSIS, (*Turp. Nepalensis*, Wall. Cat. 4277, *non* WA.; *T. pomifera var. Nepalensis*, Laws. in Hf. Ind. Fl. I. 699), panicles shorter and more compact, stiff.

HAB. Var. β. frequent in the hill-forests, especially the drier ones, and the pine-forests of Martaban, at 3000 to 7200 ft. elevation.—Fl. March.

Dodonæa, L.

1. D. VISCOSA, L. Mant. alt. 228; Hf. Ind. Fl. I. 697.—(*D. angustifolia*, L. f. Suppl. 218; Roxb. Fl. Ind. II. 256; D. dioica, Roxb. l. c.; *D. Burmanniana*, DC. Prod. I. 616; Wight Ill. t. 52; *D. pentandra*, Griff. Not. Dicot. 548).

HAB. Sandy beaches of the sea-shores of Tenasserim, from Amherst to Mergui; also Andamans, Narcondam Island.—Fr. Febr. March.

Acer, Lin.

Conspectus of species.

× Leaves simple, not lobed, with 3-basal nerves.

Leaves usually whitish beneath, the petiole 1—2 in. long; cymes glabrous, branchlets blackish, ... *A. laurinum.*

Leaves one-coloured, the petiole 3—6 lin. long; cymes panicled, glabrous; branchlets pale brown, ... *A. lævigatum.*

× × Leaves 3-lobed and 3-nerved.

Glabrous; lobes of leaves long acuminate, entire, ... *A. isolobum.*

1. A. LAURINUM, Hassk. in Tydsch. Nat. Gesch. X. 138; Miq. Fl. Ind. Bat. I/2. 582.—(*A. niveum,* Bl. Rumph. III. 193. t. 167. B. f. 1; Hf. Ind. Fl. I. 693).

HAB. Frequent in the damp hill-forests of the Nattoung mountains in Martaban; at 4000 to 7000 ft. elevation; Tenasserim; also Ava, Hookhoom valley (Griff.).

2. A. LÆVIGATUM, Wall. Pl. As. rar. II. 3. t. 104; Hf. Ind. Fl. I. 693.

HAB. Upper Tenasserim, Moulmein District (Falconer).

3. A. ISOLOBUM, Kurz in Journ. As. Soc. Beng. 1872. 302; Hf. Ind. Fl. I. 694.

HAB. Frequent in the damp hill-forests of Martaban, at 5000 to 7000 ft. elevation.

Allied to *A. trifidum,* Thbg.

Schleichera, Willd.

1. SCH. TRIJUGA, Willd. sp. pl. IV. 1096; Roxb. Fl. Ind. II. 277; Bedd. Fl. Sylv. Madr. t. 119; Brand. For. Fl. Ind. 105. t. 20; Hf. Ind. Fl. I. 681.

HAB. Common in all leaf-shedding forests, especially the mixed ones, from Ava and Martaban down to Tenasserim.—Fl. March, Apr.

Lepisanthes, Bl.

Conspectus of species.

Leaves quite glabrous, not stiff; racemes short and dense, clustered to almost solitary, axillary; pedicels very robust, about ½ lin. long; petals inside and scale glabrous, .. *L. montana.*

Leaves large and stiff; leaflets slightly puberulous on the midrib beneath, rigid; racemes in larger or smaller axillary panicles; pedicels capillary, 1½—2 lin. long; scale densely white-villous fringed; simple-stemmed, palm-like treelet, .. *L. Burmanica.*

1. L. MONTANA, Bl. Bydr. 238 and Rumph. III. 151; Miq. Fl. Ind. Bat. I/2. 562.—(*L. Browniana,* Hiern. in Hf. Ind. Fl. I. 680).

HAB. Tenasserim, Tavoy and Keloben (Wall.).

2. L. BURMANICA, Kurz MS.—(*L. montana,* Hiern. in Hf. Ind. Fl. I. 679, *non* Bl.).

HAB. Not unfrequent in the tropical forests of the eastern and southern slopes of the Pegu Yomah and in Martaban, up to 2000 ft. elevation.—Fr. Febr. March.

Leaves very similar to those of *L. sessiliflora*, Bl. I fear that I am to a certain degree to blame for Hiern's misidentification of the plant, in having referred Brandis' specimens, as also my own, to Blume's *L. montana*, under which name I also put it down in my preliminary Report on the Pegu forests. It was hardly possible to avoid such mismatchings in a Report which was drawn up in less than 15 months, in which period more than 1000 species had to be named, and keys furnished for the discrimination of the species.

Hemigyrosa, Bl.

1. H. CANESCENS, Thw. Ceyl. Pl. 56. and 408; Hf. Ind. Fl. I. 671. (*Molinæa canescens*, Roxb. Corom. Pl. I. 43. t 60 and Fl. II. 243).

HAB. Tenasserim, from Moulmein southwards.

I cannot lay so much stress upon the irregularity of the corolla or of the disk as to use it as a divisional character: the most naturally allied genera, such as *Hemigyrosa* and *Lepisanthes*, *Dittelasma*, *Erioglossum*, and *Sapindus*, or *Allophylus* and *Schmiedelia*, are forcibly removed from one another, and, indeed, it remains to be shewn whether this character can be upheld even as a generic differential. In *Sapindus trifoliatus*, L., at least, the flowers can as well be regarded as irregular, and the close affinity of this species to *Hemigyrosa canescens* cannot be denied.

Dittelasma, Hf.

1. D. RARAK, Hf. Ind. Fl. I. 672.—(*Sapindus Rarak*, DC. Prodr. I. 608; Bl. Rumph. III. 93. t. 169; *Sapindus polyphyllus*, Roxb. Hort. Beng. 29; Hf. Ind. Fl. I. 685).

HAB. Rather rare in the tropical forests of the Pegu Yomah; Tenasserim, Moulmein district, rare (Revd. Parish).

Erioglossum, Bl.

1. E. RUBIGINOSUM, Brand. For. Fl. 108.—(*E. edule*, Bl. Bydr. 229 and Rumph. III. 119. t. 166, Hf. Ind. Fl. I. 672; *Sapindus rubiginosus*, Roxb. Corom. Pl. I. t. 62 and Fl. Ind. II. 282; Griff. 548).

HAB. Frequent in the tropical, rare in the moister mixed forests, from Pegu and Martaban down to Tenasserim and the Andamans.—Fl. March, Apr.; Fr. May, June.

Allophylus, L.

Conspectus of species.

× Rachis of racemes glabrous or nearly so. Bractlets shorter than the pedicels.

Leaflets glabrous, except a tuft of hairs in the nerve-axils beneath; racemes simple; berries the size of a pepper-corn, ... *A. racemosus.*

× × Rachis of racemes more or less pubescent or villous.

All softer parts and leaves pubescent or villous-pubescent; bractlets minute; berries the size of a pepper-corn, ... *A. serratus.*

Rather glabrous, the nerves of the leaves villous above: racemes usually recurved, the bractlets linear-subulate, as long or longer than the pedicels; berries the size of a pea, ... *A. aporeticus.*

1. A. LITTORALIS, Bl. Rumph. III. 124. (*Schmidelia littoralis*, Bl. Bydr. 232; *Ornithrophe glabra*, Roxb. Fl. Ind. II. 267).

HAB. Frequent in the tidal and beach-forests, from Chittagong down to Pegu and Tenasserim; also Andamans.—Fl. Febr. to July.

2. A. SERRATUS, (*Schmidelia serrata*, DC. Prod. 610; WA. Prod. I. 110; *Schmidelia villosa*, Wight Icon. t. 401; *Ornitrophe villosa*, Roxb. Fl. Ind. II. 265).

HAB. Coast-forests from Chittagong and Arracan down to Tenasserim.

3. A. APORETICUS, (*Schmidelia aporetica*, Kurz in Journ. As. Soc. Beng. 1870. 74; *Ornitrophe aporetica*, Roxb. Fl. Ind. II. 264).

HAB. Frequent in the upper mixed forests of Arracan, up to 1200 ft. elevation.—Fl. Fr. Octob.

Hiern makes 2 species of Indian *Allophyli*, viz., those with 1- and those with 3-foliolate leaves, but this character falls to the ground, inasmuch as his *A. zeylanicus* var. 6 *grandifolia* (= *Schmidelia chartacea*, Kurz in Journ. As. Soc. Beng. 1874. 183) has sometimes 1- and 3-foliolate leaves on the same branch. I have not been able as yet to *study* this genus, but I have little doubt but that Hiern's eminently practical conclusions will not stand a scientific test.

Sapindus, Plum.

Conspectus of species.

× Leaves pubescent. Leaves unpaired-pinnate.

All softer parts pubescent; leaflets in 3—4 pairs with an odd one, ...*S. tomentosus.*

× × All parts glabrous.

O Leaves simple.

Leaves cordate at the narrowed base, the petiole very short and thick; anthers yellow; petals emarginate; the scale double, woolly; fruit-lobes the size of a pea, *S. Danura.*

Leaves acuminate or acute at the base, the petiole of the lower leaves long and longer; anthers purple: petals rounded at apex; the scale very short, simple, woolly; fruit-lobes about doubly smaller, ... *S. verticillatus.*

O O Leaves 2-foliolate.

Petiole only about 2 lin. long; leaflets oblong, about 2 in. long, sessile; panicles very slender; fruit-lobes didymous, $1\frac{1}{2}$—2 lin. long, ... *S. microcarpus.*

1. S. TOMENTOSUS, Kurz MS.

HAB. Ava, Khakhyen hills, Mynela (J. Anderson).

2. S. DANURA, Voigt. Cat. Hort. Calc. 94; Hf. Ind. Fl. I. 684, excl. syn. *S. verticillata*, Roxb.—(*Scytalia Danura*, Roxb. Fl. Ind. II. 274; *Euphoria verticillata*, Lindl. Bot. Neg. t. 1059, *non* Roxb.).

HAB. Frequent in the tidal forests of the Andamans, also in those of Pegu and Tenasserim.

In this species abnormal leaves are often observed of a semipinnate and even perfectly pinnate shape. Roxburgh's *Scytalia verticillata* is in my opinion a different plant. Wallich's Cat. 8052 D., from HBC. and hills east of Sylhet, may be taken as the type of it.

3. S. MICROCARPUS, Kurz MS.

HAB. In the adjoining Siamese province of Kanbooree (Teysman); probably also in Upper Tenasserim.—Fr. Apr. May.

Xerospermum, Bl.

1. X. NORONHIANUM, Bl. Rumph. III. 100; Miq. Fl Ind. Bat. I/2. 552.

HAB. Tenasserim (Helf. 1006).

Mr. Hiern confounds two generically different plants, viz., the true Malayan plant and *Sapindus glabratus*, Wall. (= *Cupania glabrata*, Kurz), from Sylhet and the Khasi hills.

Nephelium, L.

Conspectus of species.

* *Petals none. Calyx toothed.*

O Fruits covered with soft fleshy subulate or angular-conical prickles.

Glabrous; leaflets glaucous or whitish beneath; prickles of the fruit fleshy, long, conically angular, truncate, glabrous, ... *N. Griffithianum.*

As preceding but leaflets broader; prickles of fruit variously curved and incurved, $\frac{1}{2}$—$\frac{3}{4}$ in. long, tawny pubescent at their dilated bases, subulate or rarely 2-cleft, *N. chryseum.*

Leaflets more coriaceous, pale coloured beneath or almost one-coloured; fruits and prickles as in preceding but quite glabrous, ... *N. lappaceum.*

O O Fruits tubercled.

Leaflets very coriaceous, small, the net-venation quite obsolete, the nerves thin and faint; fruit-lobes ellipsoid-oblong, the size of a prune, covered with sharp compressed-tesselate tubercles, ..., *N. Litchi.*

* * *Petals present. Calyx cleft to $\frac{1}{2}$ or to near the base.*

Leaflets firmly coriaceous, glaucescent beneath, in drying fuscescent, the lateral nerves thin and slightly prominent; fruit-lobes oblong, shortly muricate, the murices about a line long, sharp, ... *N. rubescens.*

Leaflets thin coriaceous, more or less glaucescent beneath, the numerous (14—20) lateral nerves strongly prominent beneath; fruit-lobes ovoid-oblong, the size of a plum, perfectly glabrous, strongly tubercled as in *N. Litchi*, but not tesselate, .. *N. hypoleucum,*

As preceding but leaflets usually smaller; fruit-lobes globose, the size of a small cherry. obsoletely tubercled or almost smooth, minutely tawny velvety all over, *N. Longanum.*

1. N. GRIFFITHIANUM, Kurz in Journ. As. Soc. Beng. 1872. 303.—(*Sapindacea*, Griff. Not. Dicot. IV. 550. t. 599. fig. 1).

HAB. Ava, Khakhyen hills (Griff. J. Anderson).—Fr. May.

Hiern identifies the above species with *N. mutabile*, Bl., a species which is distinguished at once by its irregularly tubercled fruit-lobes (hence Blume formerly confounded it with *Euphoria Longan*). His description seems to have been drawn up from specimens belonging to two or three different species, but chiefly to *N. chryseum*, Bl. (Maingay No. 449, Griff. 997/1).

2. N. LAPPACEUM, Linn. Mant. I. 125 ; Hf. Ind. Fl. I. 687.—(*Scytalia Rampoutan*, Roxb. Fl. Ind. II. 271).

HAB. Upper-Tenasserim (Brandis),—cultivated ?

3. N. LITCHI, Camb. in Mém. Mus. Par. XVIII. 30 ; Wight Icon. t. 43 ; Hf. Ind. Fl. I. 687.—(*Scytalia Litchi*, Roxb. Fl. Ind. II. 269).

HAB. Chittagong, cultivated.—Fl. Febr. to March ; Fr. Apr. to June.

4. N. RUBESCENS, Hiern in Hf. Ind. Fl. I. 688.

HAB. Tenasserim (Wall.) *teste* Hiern.

5. N. HYPOLEUCUM, Kurz in Journ. As. Soc. Beng. 1871. 50 and 1874. 183, sub No. 10.

HAB. Rare in the tropical forests along the eastern slopes of the Pegu Yomah, but frequent in those of Martaban, up to 1000 ft. elevation ; also cultivated.—Fl. Jan. ; Fr. Apr.

N. B.—This species occurs also in Hindostan (Wight 540), Concan (Stocks, &c.), and wild in the sholas of the Pulney hills.

6. N. LONGAN, Camb. in Mém. Mus. Par. XVIII. 30 ; Hf. Ind. Fl. I. 689.—(*Scytalia Longan*, Roxb. Fl. Ind. II. 170 ; *Euphoria Longana*, Lamk. Dict. III. 574 ; Bot. Mag. t. 4096 ; Bot. Neg. t. 1729 ; Bedd. Fl. Sylv. Madr. t. 156 ?)

HAB. Rare in the tropical forests along the eastern slopes of the Pegu Yomah ; also cultivated.—Fl. March ; Fr. May to June.

Pometia, Forst.

1. P. TOMENTOSA. Bth. and Hf. Gen. pl. ; Hf. Ind. Fl. I. 691 pp. —(*Irina tomentosa*, Bl. Bydr. 236 ; Miq. Fl. Ind. Bat. I/2. 558 ; *Eccremanthus eximius*, Thw. in Hook. Kew Journ. VII. 272. t. 9 ; *P. eximia*, Bedd. Fl. Sylv. Madr. t. 157).

HAB. Common in the tropical forests of the Andamans.—Fr. May, June.

Distinguishable at once from *P. pinnata*, Forst., by its small and very differently shaped fruits.

Paranephelium, Miq.

1. P. XESTOPHYLLUM, Miq. Suppl. Fl. Sumatr. 509.—(*Mildea xestophylla*, Miq. Ann. Mus. Lugd. Bat. III. 88).

Hab. Tenasserim, Moulmein District (Falconer).

In HBC. are some leaves from the Khakhyen-hills which apparently represent a second Burmese species of this genus, if they should not be identical with Hiern's *Scyphopetalum*, the description of which is too imperfect to enable one to recognize from it the plant intended. They have the 3 end-leaflets similarly ternate and in texture and nervature are almost the same as the above.

Scyphopetalum, Hiern.

1. S. ramiflorum, Hiern in Hf. Ind. Fl. I. 676.

Hab. Ava, hill-forests of Hookhoom valley (Griff.) *teste* Hiern.

I have not seen this plant, and place it near *Paranephelium* simply by guess. The petals are differently described and the style is said to be obsolete,—characters which would keep it distinct from Miquel's genus.

Cupania, Plum.

Conspectus of species.

Subg. I. Eu-Cupania. Capsules clavate-pyriform, more or less conspicuously 3-lobed or angular, coriaceous.

* *Petals present, furnished with a double scale.*

× Leaves and panicles glabrous.

Leaflets opaque, glaucescent beneath, the nerves thin; rachis narrowly winged upwards, .. *C. Griffithiana.*

Leaflets glossy, one-coloured, strongly nerved and net-veined; rachis terete, *C. glabrata.*

× × Leaflets beneath and panicle shortly tawny pubescent.

Leaflets chartaceous, fuscescent in drying, opaque, ... *C. fuscidula.*

* * *Petals none or minute, without scales.*

Net-venation minute and obsolete; filaments glabrous; leaflets in 2 pairs, *C. Lessertiana.*

Net-venation strong and prominent on both sides; filaments exserted, pubescent; leaflets not fuscescent, ... *C. Sumatrana.*

Net-venation thin but prominent; filaments short, pubescent; leaflets fuscescent, .. *C. Helferi.*

Subg. II. Arytera, Bl. *Capsule nearly to the base divided into 2 divergent lobes, coriaceous.*

Leaflets chartaceous, reddish fuscous beneath, glabrous; panicles tawny puberulous, .. *C. adenophylla.*

1. C. Griffithiana, Kurz (*C. pleuropteris*, Hiern in Hf. Ind. Fl. I. 677, *non* Bl.).

Hab. Tenasserim (Helf. 983).

What Mr. Hiern describes as *C. pallidula* (Maingay 442; Griff. 982) is *C. pleuropteris*, Bl.

2. C. glabrata, Kurz in Journ. As. Soc. Beng. 1872. 303. (*Sapindus glabratus*, Wall. Cat. 8095).

Hab. Rather frequent in the tropical forests along the eastern slopes of the Pegu Yomah and also in Martaban.—Fl. Apr. May.

I do not know what Hiern describes under the above name, but generally, I think, he has my plant under view. *Sapindus squamosus*, Roxb. is *Cupania regularis*, Bl., differing from it (*Sapindacea* 4. Java, Horsfield Coll. is the typical form) in having the petiolules not incrassate.

3. C. FUSCIDULA, Kurz in Journ. As. Soc. Beng. 1872. 302; Hf. Ind. Fl. I. 677.

HAB. Tenasserim (Helf. 993).

4. C. LESSERTIANA, Camb. Mém. Mus. Par. XVIII. 46. t. 3.; Hf. Ind. Fl. I. 678.

HAB. Frequent in the tropical forests of the Andamans; Tenasserim, Mergui.—Fl. May, June.

5. C. SUMATRANA, Miq. Fl. Ind. Bat. I/2. 609; Hf. Ind. Fl. I. 678.

HAB. Rare in the tropical forests of the Central Pegu Yomah; apparently frequent in Tenasserim from Moulmein down to Mergui.—Fr. Apr. May.

6. C. HELFERI, Hiern in Hf. Ind. Fl. I. 679.

HAB. Tenasserim or Andamans (Helf.) *teste* Hiern.

Not known to me, unless No. 982/1 of Helfer's collection be meant.

7. C. ADENOPHYLLA, Planch. in Hf. Ind. Fl. I. 677.

HAB. Tenasserim, from Moulmein to Mergui.

Cardiospermum, L.

Conspectus of species.

Slightly pubescent or glabrous; leaflets often acuminate produced; flowers 1—1½ lin., .. *C. Halicacabum.*

Softly pubescent; leaflets usually short and broad; flowers 2—3 lin., ... *C. canescens.*

1. C. HALICACABUM, L. sp. pl. 925; Roxb. Fl. Ind. II. 292; Wight Icon. t. 508; Bot. Mag. t. 1049; Griff. Dicot. 546. t. 599; Hf. Ind. Fl. I. 670.

HAB. Not unfrequent in waste places, along river banks, &c., of the plains, all over Burma.—Fl. and Fr. H. and R. S.

2. C. CANESCENS, Wall. Pl. As. rar. I. 14. t. 14; Wight Icon. t. 74; Hf. Ind. Fl. I. 670.

HAB. Ava, apparently common.—Fl. Fr. ∞.

Harpullia, Roxb.

1. H. CUPANIOIDES, Roxb. Fl. Ind. I. 645; Hf. Ind. Fl. I. 691 (*Streptostigma viridiflorum*, Thw. in Hook. Journ. Bot. VI. 298. t. 9. A; *H. imbricata*, Thw. Enum. Ceyl. Pl. 56; Bedd. Fl. Sylv. Madr. t. 158).

HAB. Frequent in the tropical forests of the Andamans; Chittagong. Fl. June.

Æsculus, L.

1. A. Assamica, Griff. Not. Dicot. 541.—(*Hippocastaneæ* sp., Griff. l. c.; *A. Punduana*, Wall. Cat. 1189, *nomen nudum;* Hf. Ind. Fl. I. 675).

Hab. Damp hill-forests of Upper Tenasserim.—Fl. Apr.

Zollingeria, Kurz.

1. Z. macrocarpa, Kurz in Journ. As. Soc. Beng. 1872. 303; Hf. Ind. Fl. I. 692.

Hab. Not unfrequent in the dry forests of the Prome District, along the spurs of the Yomah.—Fl. probably close of R. S.; Fr. March.

The genus is named in honour of the late H. Zollinger, the author of so many valuable botanical papers, which, owing to their being written in the Dutch language, remain almost unknown to the majority of botanists.

[To be continued.]

XV.—*List of* Reptilia *and* Amphibia *collected by the late* Dr. Stoliczka *in Kashmir, Ladák, Eastern Turkestán, and Wakhán, with descriptions of new Species.—By* W. T. Blanford, *F. R. S., F. Z. S.*

(Received Oct. 30th,—Read Nov. 4, 1875.)

The following list of the Reptilia and Amphibia in Dr. Stoliczka's collections is similar to that of the Mammalia already printed in this Journal (*ante*, p. 104), and is similarly published in anticipation of full accounts, which cannot be issued until the accompanying illustrations are ready. It is proposed to figure all new species.

The country traversed by Sir D. Forsyth's mission, to which Dr. Stoliczka was attached as naturalist, may be considered as consisting of the following zoological subdivisions :—hills between the Panjáb and Kashmir, the Kashmir valley, Ladák (the upper Indus valley, extending to the Karakoram), the Kuenluen range south of Yárkand, Eastern Turkestán (comprising the plains around Yárkand and Káshghar), Sarikol (the hilly country between the Turkestán plains and the Pámir and Wakhán).

The collections would, doubtless, have been much larger had not a great portion of the country been traversed in the depth of winter, when the ground was covered with snow, and no reptiles could be seen. None were consequently obtained on the southern slopes of the Thian Shan mountains nor on the Pámir.

The only orders of *Reptilia* represented are those of lizards and snakes. No tortoises were met with.

REPTILIA.

LACERTILIA.

1. Stellio Himalayanus.—Ladák.
2. S. tuberculatus.—Hills between the Panjab and Kashmir.
3. S. Agrorensis.—Jhilam valley, Kashmir.
4. S. Stoliczkanus, sp. nov.

S. *squamis dorsalibus mediis majoribus, haud in lineas regulares ordinatis, obtuse carinatis, lateralibus minoribus, acute carinatis, postice subæqualibus ; nonnullis mucronatis circum tympanum, et in fasciculos ad latera colli et supra humeros dispositis ; caudalibus carinatis, mucronatis verticillatis, dorsales vix magnitudine excedentibus ; stramineus, capite dorsoque posteriore nigro-punctatis, dorso anteriore nigro, stramineo transversim fasciato.*

Hab.—Plains of Eastern Turkestán.

The distribution of the scales on the back is somewhat as in *S. Caucasicus*, but that appears to be a stouter form with far more enlarged scales on the sides, larger tail scales, and a patch of thickened scales in the middle of the abdomen which is wanting in the form now described. The present species may be near *S. Aralensis (Agama Aralensis*, Licht. in Eversmann's 'Reise nach Buchara', p. 144), the only other steppe form known, but that species is described as being very differently coloured, as having the toes fringed, and the dorsal scales strongly keeled and pointed.

5. PHRYNOCEPHALUS THEOBALDI.

P. Theobaldi, Blyth, J. A. S. B., 1863, XXXII, p. 90.
P. caudivolvulus, Günther, Rept. Brit. Ind. p. 161, *nec* Pallas.
P. Stoliczkai, Steindachner, Novara-Expedition, Reptilien, p. 23, Pl. I, Fig. 6, 7.
P. caudivolvulus and *P. Forsythi*, Anderson, P. Z. S., 1872, pp. 387, 390.

Hab. Ladák; Kuenluen; Eastern Turkestán; Sarikol.

After going through the various descriptions of *Lacerta caudivolvula* by Pallas, Eversmann, and Eichwald, and comparing their figures with the Tibetan species, I am satisfied that the form originally described by Pallas is different, and that it is probably one of the smooth species like *P. maculatus* and *P. axillaris*, both of which have a habit of coiling their tails, whilst *P. Theobaldi* has never been observed to do so. The markings on the tail in all *Phrynocephali* are very constant and those of the true *P. caudivolvulus* are different from those of *P. Theobaldi.* It is impossible to enter at length into this subject here, but in the full account of the species I shall give my reasons in full for changing the name.*

Although the form called by Dr. Anderson *P. Forsythi* appears distinct at first and is, as a rule, differently coloured on the body, I can find no constant distinction from *P. Theobaldi.*

6. P. AXILLARIS, sp. nov.

P. *major, lævis, cauda elongata, pede anteriore in adulto vix femur attingente, squamis omnibus lævibus, caudæ apicem versus exceptis; supra griseus, maculâ rubrâ utrinque post axillam notatus, membris caudaque fasciis fuscis transversis signatis, hac ad medium fusco-annulatâ, nunquam ad apicem nigrâ, subtus albidus. Long. tota poll.* 5—6, *caudæ* $\frac{3}{5}$ *totius longitudinis subæquante.*

* I should, however, mention that I think there is reason to doubt whether the specimens assigned to *P. caudivolvulus* in the Berlin Museum are rightly named. It was upon Dr. Peters's comparison of Tibetan specimens with the former that Dr. Günther based his identification. At all events, the characters of a specimen from the Berlin Museum described by Dumeril and Bibron differ from the original description given by Pallas.

Hab.—Eastern Turkestán, in the plains.

A large, rather long-tailed species, with the same structure as *P. maculatus* and the same habit of coiling its tail. It is distinguished, when adult, by its limbs being shorter and the toes less fringed, and by colouration. *P. axillaris* has a red spot behind each shoulder so as to be partly concealed by the fore limb when laid back and it never has the tip of the tail black whilst *P. maculatus* always has.

7. TERATOSCINCUS KEYSERLINGII.—Eastern Turkestan.

8. GYMNODACTYLUS STOLICZKÆ.

Cyrtodactylus Yarkandensis, Anderson. P. Z. S., 1872, p. 381.

Hab.—Ladák.

From an examination of Dr. Anderson's type specimen, I have ascertained that it is identical with the species previously described and figured by Steindachner (Rept. Nov. Exp. p. 15, Pl. II, fig. 2). I also think that Dr. Anderson must have been misinformed as to the original locality of the specimen he described, for the species abounds in Ladák, whilst it is replaced by other forms of the genus at Yárkand.

9. G. ELONGATUS, sp. nov.

G. *elongatus, corpore gracili, caudâ attenuatâ, membris exilibus, dorso tuberculis majoribus latis confertis ornato, inter tuberculas squamis rotundis parvulis induto, caudâ subtus scutis majoribus instructâ, verticillatâ serie ultimâ verticilli cujusque ex squamis majoribus carinatis superne et ad latera omnino compositâ, poris præanalibus ad* 5; *griseus transverse fusco fasciatus. Long. poll.* 5, *caudæ* 2.8.

Hab.—Yangihissar, Eastern Turkestán.

A peculiarly elongate form of the group of *G. Caspius*, distinguished from that and all allied species by its slenderness and by the peculiarity of the tail having no spinose tubercles, but only the last row of scales in each ring enlarged and carinate without any intervening small scales.

10. G. MICROTIS, sp. nov.

G. *parum robustus, capite brevi, depresso, meatu auditorio minimo; caudâ attenuatâ, lævi, haud verticillatâ, membris breviusculis; dorso granulato, tuberculis subcarinatis ornato; arenarius, fusco minute punctatus, subtus albescens. Long. tota* 3.2 *poll., caudæ* 1.8.

Hab.—Eastern Turkestán.

A small sandy coloured species with a smooth tail and the back tuberculated. It is remarkable for its very small ear-orifice. It appears to be a house-gecko and was found about old walls. It is probably allied to the species described by Pallas under the name of *Lacerta pipiens*, but that

is said by its describer to have all the back scales granular, and to be marked with angulate cross bands.

11. Eremias Yarkandensis, sp. nov.

E. cæruleo-ocellata, Anderson, P. Z. S., 1872, p. 373, *nec* Dum. et Bib.

E. *gracilis, supra grisea vel olivacea, nigro-maculata, ocellis albidis nigro marginatis utrinque ad dorsum in seriem longitudinalem dispositis; subtus albida; scutis nasalibus haud tumidis, præfrontali unico, a rostrali supranasalibus atque a verticali postfrontalibus longe disjuncto; infra-orbitali ad labrum pertinente; dentibus palatalibus nullis; scutis ventralibus in series longitudinales (potius obliquas)* 14—16, *et in transversas ad* 30 *dispositis; poris femoralibus utrinque* 9—14, *squamis infradigitalibus vix carinatis. Long.* 6 *poll., caudæ* 3.7.

Hab.—Eastern Turkestán.

This species was referred by Dr. Anderson to *E. cæruleo-ocellata* of Dumeril and Bibron, but it appears to me to differ in having the nasal shields not swollen, the dorsal scales closer together, almost without intervening granules, and, I think, in being more slender. *E. cæruleo-ocellata* has the tail scales keeled; as a rule they are smooth in the basal portion in *E. Yarkandensis* but the character is not constant. This species appears more closely allied to *E. multiocellata* Günther and may perhaps be identical, but that form is described as having an azygos shield between the postfrontals, an enlarged shield in the middle of the collar, and 18 rows of scales across the belly. I scarcely think, too, that Dr. Günther would have omitted to mention the absence of tumidity in the nasal shields which distinguishes *E. Yarkandensis* from other forms of the genus.

11*a*. E. Yarkandensis, var. saturata.

E. Yarkandensis *magis infuscata, scuto infra-orbitali diviso, parte superiori a labro discreto.*

Hab —Valleys of the Kuenluen range, south of Yárkand.

This differs from the type in having the infra-orbital shield divided, and in darker colour. Neither character, however, is quite constant, and there is one dark specimen with the infra-orbital undivided.

12. Eremias vermiculata, sp. nov.

E. *supra grisea, nigro-vermiculata, subtus albida, elongata, gracilis; dorso granulosa, scutis nasalibus tumidis, præfrontali unico a rostrali supranasalibus atque a verticali postfrontalibus longe disjuncto; supra-orbitalibus convexis, omnino squamis minimis rotundis circumdatis; infra-orbitali late ad labrum pertinente, dentibus palatalibus nullis; scutis ventralibus in series* 16—20 *longitudinales (potius obliquas), atque* 36—41 *transversus dispositis; poris femoralibus utrinque* 19—23; *squamis infradigitalibus vix carinatis. Long.* 7·4 *poll., caudæ* 5·1.

Hab.—Eastern Turkestán.

Allied to the last, but more slender with a longer tail and longer limbs. It has more numerous ventral scales and femoral pores, swollen nasal shields, the supraorbital disk surrounded by granules, and different colouration.

13. EUMECES TÆNIOLATUS.—Between Mari in the Panjáb and Kashmir.

A single specimen 13 inches long, stouter than the type, and with 23 rows of scales round the body.

14. MOCOA HIMALAYANA.—Mari, Panjáb; Kashmir.

15. M. STOLICZKAI (? = *M. Ladacensis*).

Euprepes Stoliczkai and *E. Kargilensis*, Steindachner, Novara Expedition, Reptilian, pp. 45, 46.

Eumeces Ladacensis, Anderson, P. Z. S., 1872, p. 375.

Hab.—Ladák.

I am unable to identify this species satisfactorily with *Eumeces Ladacensis*, Günther, because in not one out of the twenty-four specimens collected does the forefoot reach the end of the snout. Anderson also noticed this Still I think it probable that the two are identical.* *E. Kargilensis* was chiefly distinguished by Steindachner because of its having 4 instead of 5 supralabials before the infraorbital. In some specimens collected there are 4 on one side and 5 on the other.

OPHIDIA.

16. TYPHLOPS PORRECTUS?—Jhilam valley between Mari and Kashmir.

This appears stouter than the type and may be distinct. Only a single specimen was obtained.

17. COMPSOSOMA HODGSONI.—Kashmir.

18. PTYAS MUCOSUS.—Kashmir.

19. ZAMENIS RAVERGIERI.

Coluber Ravergieri, Men. Cat. Rais. p. 69, (1832).

Zamenis caudælineatus Günther, Cat. Col. Snakes, Brit. Mus., p. 104 (1858).

Z. Ravergieri and *Z. Fedtschenkoi*, Strauch, Schlangen des Russischen Reichs, Mem. Acad. Sci. St. Pet. XXI, No. 4, p. 127 (1873).

Hab.—Eastern Turkestán.

The colouration of the three specimens obtained is that of the variety called by Strauch *Z. Fedtschenkoi*, in which the tail is spotted instead of being striped. In describing the specimens found in Persia, I have shewn that the two forms pass into each other.

* The locality of *E. Ladacensis*, Günth. Rept. Brit. Ind. p. 88, rests upon the authority of the Messrs. Schlagintweit, and consequently no reliance can be placed upon its accuracy.

20. Tropidonotus hydrus.—Eastern Turkestán.

21. T. platyceps.—Mari and Kashmir.

22. Taphrometopum lineolatum.—Eastern Turkestán.

23. Vipera obtusa.

V. Euphratica, Martin, P. Z. S., 1838, p. 82.
V. obtusa, Dwigubsky, *teste* Strauch Mem. Acad. St. Pet. XXI, No. 4, p. 221.

24. Halys Himalayanus.—Mari and Kashmir.

AMPHIBIA.

BATRACHIA.

1. Rana cyanophlyctis.—Between Mari and Kashmir.

2. Diplopelma carnaticum.—Tináli between Mari and Kashmir.

3. Bufo viridis.—Kashmir ; Eastern Turkestán ; Wakhán.

4. B. calamita ?—Kashmir.

XVI.—*Notes on a few new Oaks from India.—By* S. Kurz.

(With Plate XIV.)

(Received Sept. 30th ;—Read Nov. 4th, 1875.)

Some time ago I received, through the kindness of Capt. J. Waterhouse, two acorns collected by Capt. W. G. Hughes, Deputy Commissioner of the hill-districts of Arracan. They were obtained in the hills of Arracan at some 5000 or 6000 ft. elevation and proved interesting, the one as being a full-grown acorn of *Quercus mespilifolia*, a species previously known only from Ava and Prome and which I have hitherto considered (see Flora, 1872, p. 398) to be only a variety of *Q. semiserrata*, but which I must now acknowledge as an entirely distinct species ; the other as being a young specimen of a new species of which a full-grown cluster of acorns from Assam exists in the Calcutta Herbarium. I have in vain tried to obtain either flowers or leaves of this species from the Khasya Hills, and, consequently, am compelled to name and describe it solely from the fruit. I have to do the same in the case of to *Q. olla*, another new species from Assam. The figures, however, will, I hope, assist in their future identification. I take this opportunity of giving descriptions of a few other new species collected by myself and others in the Sikkim Himalaya and Burma.

1. Quercus xylocarpus, nov. sp., Pl. XIV, Figs. 5—8.

Fructus per 2—3 in massam irregulariter obovoideam 1—2 poll. in diametro connati ; nuces apice tantum liberæ, depresso-globosæ, læves ; cupulæ dum immaturæ nuces omnino includentes demum circulariter apertæ et nucis

apicem exponentes, grosse et irregulariter lignoso-muricatæ, glabræ, tuberculis (resp. squamis) brevi-conicis obtusiusculis lineam circiter longis marginem versus minoribus et obsoletis obsolete-multiseriatim obtectæ.

HAB.—Arracan Yomah, east of Akyab, at 4000 to 5000 feet elevation; Assam. (Hughes).

2. QUERCUS OLLA, nov. sp., Plate XIV, Fig. 9.

Rami adulti læves, nigri; spica fructifera c. 4 pollicaris, robusta; cupulæ liberæ cum 1—2 parvis abortivis basi adnatis, subturbinatæ, poll. in diametro et circiter ½ poll. altæ, crassissimæ, fulvello-tomentellæ, squamis numerosissimis latissimis atque breviter et abrupte acuminatis multiseriatis obductæ; glans depresso-globosa e cupulâ vix exserta, lævis, nitens, subcapitato-mucronata.

HAB.—Assam (Jenkins).

3. QUERCUS PACHYPHYLLA, nov. sp., Plate XIV, Figs. 1—4.

Arbor 50—60-pedalis, glabra, ramulis nigris, gemmis glabris; folia oblongo-lanceolata, petiolo crasso 2—3 lin. longo suffulta, longe et magis minusve abrupte acuminata, basi inæquali acuta, crasse coriacea, 3—5 poll. longa, costa nervisque circiter 8 utrinque supra impressis subtusque crasse prominentibus percursa; spicæ femineæ crassæ, pruinosæ, 3—4 poll. longæ; flores feminei 2—4- (vulgo 3-) ni; perigonium brunneo-squamatum villosulum; stigmata 3, raro 4, crasse linearia, lin. fere longa, erecto-patentia; pedunculus fructigerus crassus, 2—4 poll. longus; cupulæ maturæ 1–1½ poll. in diametro, crasse coriaceæ, cinereo- v. subgilvo-tomentellæ, squamis lato-ovato-trigonis acutis crassis in series circiter 9—12 indistincte annulatim dispositis, vulgo per 2—3 et plures in massam magis minusve confluentes; glans pollicem circiter lata, depressiuscule hemispherica, bene evoluta e cupulâ fere semiexserta, glabra, nitida, in glomeribus nondum evolutis minus exserta.

HAB.—Frequent in the hill-forests of the Tongloo and Phalloot mountains at 7—8000 ft. elevation (collected also by G. Mann, S. Gamble, etc.)

This species as well as the two foregoing all belong in the vicinity of *Quercus spicata*. *Q. pachyphylla* very much resembles *Q. squamata*, Roxb., a species which in my opinion is incorrectly referred as a synonym to *Q. spicata*.

4. QUERCUS FALCONERI, nov. sp.

Arbor glabra; folia iis *Goniothalami sesquipedalis* simillima, elongato-oblonga, 1½—1 ped. longa, basi acuta, petiolo crasso glabro 3—4 lineali suffulta, breviter acuminata v. apiculata, tenuiter coriacea, utrinque lucida, glabra, nervis numerosis (circiter 20 utrinque) supra impressis, subtus prominentibus,

reticulatione satis obsoletâ; spicæ fructigeræ $1\frac{1}{2}$ ped. circiter longæ, tomentellæ, glandes obovoideo-globosæ, pollicem fere latæ, læves, styloso-apiculatæ, pallide brunneæ et nitidæ, exsertæ; cupulæ concavo-explanatæ, marginibus plus minusve revolutis, crasse coriaceæ, extus ferrugineo-velutinæ, intus canescenti-sericeæ, liberæ v. rarius basi tantum connatæ, squamis numerosis triangularibus parvis appressis obductæ.

Hab.—Upper Assam (Falconer). Very nearly allied to *Q. Amherstiana*, Wall.

5. Castanea diversifolia, nov. sp.

Arbor 40—60-pedalis, novellis fulvo-pubescentibus; folia valde variabilia, novella chartacea, ovato-oblonga ad ovata, 7—9 poll. longa et 4—$4\frac{1}{2}$ poll. lata, petiolo semipollicari pubescenti suffulta, in nervis utrinque parum pubescentia, nervis reticulatione laxâ crassâ et conspicuâ; adulta multo minora, coriacea, elliptico-oblonga, breviter et obtuse acuminata, $4\frac{1}{2}$—6 poll. longa, utrinque pagina v. petiolo et in nervis utrinque puberula et glabrescentia, squamis minutis argenteis destituta; paniculæ magnæ et robustæ, apicibus ramulorum congregatæ dense fulvo v. cinereo-tomentosæ; fructus involucrum $1\frac{1}{2}$ poll. fere in diametro, spinis obtectum; spinæ simplices, strictæ, pubescentes, circa 4 lin. longæ.

Hab.—Common in the drier hill forests of Martaban, at 3,500—5000 ft. elevation.

I describe this species as a *Castanea* connecting *Castanopsis* (including *Lithocarpus*) with *Castanea*. This, of course, is quite a practical division for the differences between all these genera are simply artificial ones.

Explanation of Plate XIV.

Figs. 1—4. *Quercus pachyphylla*, Kurz. Fig. 1, fruiting spike; fig. 2, leaf-branch; fig. 3, female inflorescence; fig. 4, female flowers, somewhat magnified.

Figs. 5—8. *Quercus xylocarpa*, Kurz. Figs. 5 and 6, ripe fruit clusters, from above and from below; fig. 7, unripe, ditto, from Arracan; fig. 8, scales, somewhat magnified.

Fig. 9. *Quercus olla*, Kurz. Acorns, from the side and from above; natural size.

XVII.—*On a new Species of* Tupistra *from Tenasserim.*—*By* S. Kurz.

(Received Sept. 30th;—Read Nov. 4th, 1875.)

From amongst the many fine plants which I owe to the late Dr. F. Stoliczka I have selected for description this new species of *Tupistra*, a genus that has hitherto been supposed to be monotypic. The present species is remarkable for its stiff robust erect spikes, those of *T. nutans* being short,

comparatively slender, and so much decurved that the fruits when ripe are usually buried in the mould of the dark forests in which the plant grows.

Baker, in his Revision of *Asparageæ* (Journ. Linn. Soc., XIV. 581), adds a doubtful species (*T. ? Singapuriana*, Wall.) to the genus. Of this I have seen only a very bad specimen without fruit or flower, but to me it appears a *Hypoxidea* or more likely a species of *Apostasia*. The same author makes *Veratronia*, Miq., a *Palmacea* (from which the fleshy scanty albumen would alone remove it), having evidently overlooked a little note of mine on this genus in the Flora, 1873, p. 224, where I have identified the plant with *Susum anthelminticum* of Blume. In this note I have inadvertedly overlooked *Susum minus*, Miq. Suppl. Fl. Sumatr. 598, which should be added as a synonym to *S. Kassintu*, Kurz.

TUPISTRA STOLICZKANA, nov. sp.

Herba perennis 3—4-pedalis, glabra; folia iis *T. nutantis* similia sed multo majora et latiora, lanceolata, utrinque acuminata, in petiolum 1—1½ pedalem complicatum membranaceo-marginatum decurrentia, 2½—3 ped. longa, 4—5 poll. lata, chartacea; spicæ radicales, circ. 1 ped. altæ, strictæ erectæ, robustæ, pedunculo c. 4 pollicari suffultæ, glabræ; flores sessiles, mediocres, ½—⅔ poll. in diametro, bracteâ latissimâ cucullatâ obtusâ infractâ sustenti; corolla 6-loba, tubus urceolato-campanulatus, limbi laciniæ lineari-lanceolatæ c. 3 lin. longæ, obtusiusculæ, basi ad faucem antheram sessilem oblongam utrinque truncatam 2-locularem gerentes; ovarium ovoideum, 3-loculare; stylus sulcatus, crassus, circ. 1 lin. longus; stigma magnum, convexo-peltatum, lobatum, scabrum; baccæ valde immaturæ ovoideo-globosæ, cerasi magnitudinis.

HAB.—Upper Tenasserim, Moulmein District (Dr. F. Stoliczka).

XVIII.—*Descriptions of new Indian Plants.—By* S. KURZ.

(With Plate XV.)

(Received Sept. 30th;—Read Nov. 4th, 1875.)

1. ZANTHOXYLON ANDAMANICUM, nov. sp.

Frutex semiscandens, aculeis sparsis subcurvis brevibus armatus, novellis parce pubescentibus; folia imparipinnata, 2—4 poll. longa, petiolo inermi anguste alato; foliola 3—4-juga cum impari, subsessilia, inæquali-rhomboidea (terminali cuneato-obovato), ½—1 poll. longa, obtusa, membranacea, margine exteriori salvo apicem versus integra, secus interiorem grosse crenata, subtus in costâ parce pubescentia; cætera ignota.—*Andamans.*

2. AGLAIA PANICULATA, nov. sp.

Arbor mediocris, sempervirens, novellis dense fulvo- v. cupreo-lepidoto-puberulis mox glabrescentibus; folia impari-pinnata, glabra, rhachi terete

cupreo-lepidotula glabrescente; foliola vulgo 2-juga cum impari, suboppo-sita, ovata ad ovato-oblonga, petiolulo ferrugineo-lepidoto 2—2½ lineali suffulta, 4—9 poll. longa, coriacea, glabra, opaca, foliolis summis ternatis v. pinnato-remotis; flores minuti, pedicellis gracilibus brevibus ferrugineo-lepidotis, in paniculas amplas ferrugineo lepidoto-tomentosas axillares foliorum longitudine v. paullo breviores dispositi; calyx ferrugineo-lepidotus, lobis latis obtusis; petala semilineam longa, libera; antheræ 5; baccæ ignotae.—*Pegu; Tenasserim.*

3. Amoora lactescens, nov. sp.

Arbor sempervirens, usque 40-pedalis, novellis pallide lepidotis, succo lacteo scatens; folia impari-pinnata, rhachi terete, lepidotula, mox glabrescentia; foliola 3—2-juga cum impari, alterna, oblonga ad lanceolato-oblonga, petiolulis 2—3 lin. longis suffulta, basi acutâ obliqua, acuminata, chartacea, viridia, glabra, 3—5 poll. longa, nervis venisque supra bene conspicuis; flores majusculi, pedicellis curvis argenteo-lepidotis 1—1½ lin. longis suffulti, paniculam axillarem petiolo breviorem laxam sessilem gracilem parce ramosam dense lepidotam efformantes; calyx dense lepidotus; petala 3, lineam circiter longa v. paullo longiora, concavo-rotundata, glabra; antheræ 6; fructus obovoideo-globosi, juniores furfuraceo-lepidoti, cerasi magnitudine.—*Martaban.*

4. Amoora dysoxyloides, nov. sp.

Arbor sempervirens, mediocris, novellis cinereo-lepidotis; folia impari-pinnata, pedem circiter longa, rachi petiolo et costâ subtus dense canescenti-lepidotis; foliola 3-juga cum impari, alterna, oblonga, basi oblique acuta, petiolulis 2—3 lin. longis lepidotis suffulta, subabrupte et obtusiuscule acuminata, tenuiter coriacea, nigrescentia, opaca, subtus sparse et minute argenteo-lepidota; flores parvi, pedicellis brevibus crassis lepidotis suffulta, in paniculam axillarem parvam petiolo multo breviorem dense canescenti- v. gilvo-lepidotam sessilem disgesti; calyx brevis, dense lepidotus, 5-dentatus; petala 5, lineam vix longa, obovato-oblonga, glabra; tubus stamineus glaber; antheræ 10; ovarium ovoideum, pallide hirsutum; stigma sessile, magnum, glabrum.—*Martaban.*

5. Walsura oxycarpa, nov. sp.

Arbor, gemmis fulvescenti-puberulis; folia impari-pinnata, petiolo rachique sparse lenticellatis glabris gracilibus; foliola bijuga cum impari, petiolulis ½—¼ pollicaribus gracilibus suffulta, lanceolata ad oblongo-lanceolata, 3—4½ poll. longa, tenuiter chartacea, longiuscule acuminata, subtus glaucescentia reticulatione tenuissimâ et inconspicuâ percursa; paniculæ fructigeræ gracillimæ et longe pedunculatæ, parce ramosæ, glabræ, foliis breviores; baccæ immaturæ ovato-oblongæ, acuminatæ, ½ poll. longæ, cinereo-velutinæ.—*Andamans.*

Daphniphyllopsis, nov. gen. *Olacinearum.*

Pl. XV, Figs. 1—7.

Calyx 5-lobulatus, accrescens. Petala 5, raro 6—7, cum ovario connata, libera. Stamina perfecta 10, irregulariter v. alternatim longiora. Ovarium inferum, pedicelliforme, disco epigyno majusculo annulari coronatum; stylus perbrevis, simplex. Fructus cum calyce aucto connatus, disco epigyno et calycis lobulis coronatus.—Arbor magna, foliis simplicibus integris. Flores parvi, sessiles, in capitula pedunculata axillaria congesti.

6. D. capitata, (*Ilex daphnephylloides*, Kurz in Journ. As. Soc. Beng. 1870—72).

Descriptioni adde: Flores non pedicellati, sed cum ovario pedicelliformi sessiles; ovarium inferum, cum calyce connatum, parce pubescens, apice disco epigyno glabro crasso annulari obscure lobato terminatum; baccæ immaturæ obovoideæ, c. 3 lin. longæ, parce pubescentes.—*Montes Himalayæ Sikkimensis et Martabaniæ,* 5—7000 *ped. s. m.*

Natsiatopsis, nov. gen. *Olacinearum.*

Pl. XV, Figs. 8—9.

Flores fertiles ignoti; masculi: calyx 4-fidus, parvus. Corolla tubulosa, apice 4-loba. Stamina 4, libera, cum corollæ lobis alterna; filamenta longa, lata; antheræ lineari-oblongæ. Ovarii rudimentum dense hispidum.—Herba perennis, volubilis, scabra, foliis alternis cordato-ovatis palmatinerviis. Flores in spicas vulgo geminas axillares graciles dispositi; bracteæ deciduæ.

7. N. Thunbergiæfolia, nov. sp.

Herba perennis, volubilis, scabro-puberula; folia cordato-ovata v.-oblonga, 5—6 poll. longa, petiolis 2—2½ poll. longis suffulta, breviter acuminata, supra scabra, subtus dense pubescentia, a basi 7-nervia; flores masculi brevissime pedicellati, 2 lin. circiter longi, in spicas ternas v. saepius geminas axillares laxas elongatas tomentellas disgesti; calyx parvus, 4-fidus, pubescens; corolla gamopetala, tubulosa, extus appresse pubescens, 4-loba, lobis brevibus reflexis; stamina 4, cum corollae lobis alterna, filamenta libera, lato-linearia; ovarii rudimentum hemisphericum, dense fulvo-hispidum.—*Ava.*

8. Miquelia cancellata, nov. sp.

Frutex volubilis, ramis tortuoso-striatis; folia oblongo-lanceolata, basi attenuata, petiolo circiter pollicari suffulta, 4—5 poll. longa, acuminata, rigide coriacea, lucida, subtus exigue puberula glabrescentia nervis et reticulatione crassis prominentibus percursa; drupæ (pericarpio deprivatæ) obovato-oblongæ, margines versus compressiusculæ, pollicem circiter longæ, elegan-

tissime at grosse cancellatæ; semen solitarium, endocarpio crustaceo conforme sed minus, cancellato-nervosum, pendulum. *Malacca* (Maingay No. 376).

Descriptio e specimine valde fragmentario confecta.

9. Ilex Sikkimensis, nov. sp.

Arbor mediocris, glabra, ramis crassis, gemmis ample squamatis; squamæ lato-ovales, obtusissimæ, c. ½ poll. longæ, glabræ, lato scarioso-marginatæ; folia larga, oblonga, basi in petiolum ½—1 pollicarem crassum attenuata, obtusiuscula, 5—6 poll. longa, repando-serrulata, coriacea, glabra; cymæ fructiferæ densæ, breves, robustæ, e perulis axillaribus v. supra foliorum cicatricibus ortæ, glabræ; baccæ globosæ, piperis grani magnitudine, læves, luteæ, pedicellis strictis c. 3 lin. longis suffultæ, stigmate sessili peltato-4-lobo coronatæ, 4-pyrenæ; pyrenæ trigonæ cum dorso convexo sublæves.—*In sylvis montanis subtemperatis Himalayæ Sikkimensis, alt.* 7—10000 *ped. s. m.* Fr. Oct.

Aff. *I. odoratæ,* gemmis maximis et drupis luteis 4-pyrenis jam distincta.

10. Gymnosporia Thomsoni, nov. sp.

Arborea, glabra, spinis nudis rectis armata, ramulis lenticellatis; folia lanceolata ad oblonga-lanceolata, petiolo gracili 2—3 lin. longo suffulta, 2—5 poll. longa, tenuiter acuminata, crenato-serrulata, membranacea, glabra, in sicco fuscescentia v. nigrescentia; flores parvi, 5-meri, pedicellis gracillimis 1—2 linealibus, cymas a basi fasciculato-ramosas pollice vix longiores axillares v. supra foliorum delapsorum axillis ortas efformantes; petala lin. circiter longa; capsulæ pisi majoris magnitudine, lato-obovatæ, acutiusculæ, læves, vulgo ultra medium bivalvato-dehiscentes, 2—1-loculares et 2—1-spermæ.—*Sikkim Himalaya alt.* 2—5000 *ped. s. m.*; *Bootan, montes Dewangaree* (Masters) Fl. Apr. Fr. Sept. Oct.

Sub eodem nomine cum *Celastro monosperma* ex herb. Kewensi distributa.

11. Gymnosporia Gibsoni, nov. sp.

Frutex spinis crassis rectiusculis longis folii- et florigeris, armatus, novellis puberulis; folia obovata, petiolo 1—1½ lin. longo suffulta, apiculata ad obtusa, 1—2½ poll. longa, obsolete crenata, membranacea, in sicco brunnescentia, subtus puberula, supra glabra; cymæ fructigeræ folio paullum breviores, e spinis v. earum axillis ortæ, puberulæ, glabrescentes, graciles, pedunculatæ, dichotomo-ramosæ; capsulæ immaturæ glabræ, obpyriformes, vulgo 3-lobatæ et 3-loculares, ⅓ poll. longæ, 3-valvatæ, loculis monospermis.—*Bombay Presidency* (Dr. Gibson).

12. Lophopetalum fuscescens, nov. sp.

Arbor glabra; folia oblonga, petiolo 1—1½ pollicari suffulta, breviter acuminata, basi obtusa, integra, 4—8 poll. longa, coriacea, opaca, subtus

rubido-fuscescentia, nervis confertiusculis 14—16 utrinque; cymæ rigidæ, brachiatæ, in paniculam terminalem glabram consociatæ; pedunculi $1\frac{1}{2}$—2 poll. longi, ramuli ultimi breves compresse 4-goni; flores parviusculi, pedicellis gracilibus lineam circiter longis suffulti, confertiusculi; calycis lobi breves, lati, rotundati; petala ovata, obtusiuscula, lin. longa, coriacea, margine lato membranaceo in alabastro induplicato aucta, cæterum nuda, in sicco in centro elongato-trigono-corrugata; discus indistincte 5-lobulus, in sicco rugulosus; stamina 5; filamenta longiuscula.—*Singapore.*

13. Salacia Jenkinsii, nov. sp.

Scandens ?, glabra; folia petiolo 2—3 lin. longo suffulta, oblonga ad elliptico-oblonga, 5—7 poll. longa, apiculata v. abrupte et obtuse acuminata, basi obtusa v. rotundata, obsolete crenata, chartacea, glabra; flores majusculi, pedicellis c. $\frac{1}{3}$ pollicaribus suffulti, cymas dichotomas glabras in paniculam elongatam terminalem v. in summorum foliorum axillis sitam dispositam formantes; sepala lato-ovata, $\frac{1}{2}$ lin. longa, glabra; petala imbricata, obovata, obtusa, lineam longa v. longiora, glabra; stamina 3; filamenta subulata, lata, plana, recurva, $\frac{1}{2}$ lin. longa; discus urceolatus, ovarium fere totum includens.—*Assam* (Jenkins).

14. Salacia platyphylla, nov. sp.

Frutex alte scandens, glaber; folia ovalia v. elliptico-ovalia, petiolo $\frac{3}{4}$—$\frac{2}{3}$ pollicari suffulta, obtusiuscule acuminata v. rarius apiculata, basi rotundata, integra coriacea, 4—6 poll. longa, opaca; flores majusculi, viridiusculi, pedicellis circa semipollicaribus lævibus crassiusculis suffulta, perplures e tuberculis axillaribus v. supra foliororum delapsorum cicatricibus orti; calycis lobi brevissimi et latissimi, integri, glabri; petala subvalvata, obovata, $1\frac{1}{2}$ lin. longa, glaberrima; discus magnus et crassus, glaber; stamina 3; antheræ minutæ; filamenta plana, deorsum latiora, reflexa, in floribus sterilibus (?) lineam fere longa, in floribus fertilibus valde abbreviata; baccæ magis minusve globosæ, cerasi maximi magnitudine, coccineæ, læves, 2-spermæ; semina semi-convexiuscula, $\frac{3}{4}$ poll. longa, obsolete et grosse rugosa.—*Nicobars.*

Ex affinitate *S. reticulatæ.*

15. Hippocratea Nicobarica, nov. sp.

Frutex alte scandens, glaberrima ramulis sparse et minute lenticellatis; folia petiolo 3—4 lin. longo crasso suffulta, elliptica ad elliptico-oblonga, 5—6 poll. longa, basi obtusa, obtuse repanda, apiculata, coriacea, nitida, glauca; flores lutescentes, parvi, pedicellis $2\frac{1}{2}$—3 lin. longis suffulti, in cymas dichotomo-ramosas pedunculatas vulgo ternas terminales dispositi; bracteæ et bracteolæ minutæ, acutæ; calycis lobi parvi, ovati, acuti, ciliati; petala rotundata, imbricata, $\frac{1}{2}$ lin. vix longa; discus convexus in marginem planum 5-gonum explanatus, ovarium fere totum includens; stamina 3, parva, subsessilia.—*Nicobars.*

16. Vitis costata, Wall.

Humilis, prostrata v. scandens, ramulis 6-gonis, junioribus parce appresse hirsutis; folia simplicia, petiolo brevi 1—2½ lin. longo suffulta, ovato- v. subcordato-lanceolata, acuminata, repandocrenulata, basi rotundata v. subcordata, succoso-membranacea, concoloria, 4—6 poll. longa, subtus in nervis rectis parallelis prominentibus parce appresse hirsuta; flores ...., in cymas parvas strictiusculas oppositifolias v. in ramulorum extremitatibus paniculatim dispositas collecti; pedunculus circ. ½ pollicaris et ramificationes strictiusculi, juniores appresse hirsutuli; baccæ piperis grani magnitudine, pedicello subnutante 2—3 lineari sursum incrassato suffultæ, obovoideæ.—*Pegu; Martaban; Prome.*

17. V. neurosa, nov. sp.

Scandens, lignosa, glaberrima; cirrhi firmi, simplices?, oppositifolii; folia digitato-5-foliolata, glaberrima, etiam in sicco glauco-viridia, petiolo 2—3 pollicari suffulta; foliola oblonga, lateralia obliqua, petiolulis crassis 3—5 lin. longis suffulta, basi obtusa v. acuta, irregulariter et grossiuscule serrata, obtusiuscule acuminata, 3—4 poll. longa, coriacea, nervis et reticulatione utrinque (subtus magis) conspicua; flores parviusculi, cymulosi, pedicellis 2—3 linealibus suffulti; cymulæ elongato-pedunculatæ, cymam iterato umbellatam glabram pedunculo circiter 2 pollicari basi bracteato axillari suffultam efficientes; calyx truncatus; ovarium ovoideum, in stylum crassum apice patenter 4-lobum attenuatum; baccæ oblongæ, ½ poll. longæ, glabræ, 1—3 spermæ; semina oblonga, v. si 2 v. 3, semi-v. trigono-oblongæ, 4—6 lin. longæ, dorso leviter longitudinaliter depressæ.—*Khasya montes, alt.* 3—4000 *ped. s. m.* (*Vitis* No. 44, Hf. and Th.).

18. V. Vicaryana, nov. sp.

Gracilis, glabra; folia tripinnatisecta ad ternatisecta, 2—3 poll. longa, pinnæ inferiores vulgo 5- superiora 3-foliolata; foliola petiolulis capillaribus ½ lin. vix longis (terminali petiolulo usque ad ½ poll. longo) suffulta, parva, ½—¾ pollicaria, ovata ad lato-ovata, grosse crenato-repanda, acuta, rigide chartacea, glabra, in sicco supra nigrescentia subtus fuscescentia; paniculæ furcato-cymosæ, oppositifoliæ, pedunculo pollicari suffultæ; flores etc. omnes delapsi.—*Deyrah Dhoon* (Capt. Vicary, 1833).

Species elegantissima ex affinitate *V. Cantoniensis.*

19. Sapindus tomentosus, nov. sp.

Arbor? pubescens, habitu *Erioglossi* etc.; folia paripinnata cum rhachi et petiolulis tomentella; foliola 4—3-juga, 4—5 poll. longa, 2—3 poll. lata, inæquali ovato-oblonga, basi inæquali acuta, breviter petiolulata, acuminata v. acuta, integra, chartacea, supra nervis puberulis exceptis glabra, subtus dense tomentella; panicula tomentella, terminalis; sepala oblongo-lanceolata,

acuta, extus pubescentia; petala elongato-cuneata, basin versus villosula; lamina obovata medio squamâ bifidâ intus dense lanuginosâ aucta; filamenta longe pilosa; stylus sub fructu juvenili simplex, continuus; drupæ immaturæ pedunculatæ, bilobæ, lobo altero abortivo, stylo acuminatæ, monospermæ, basi intus dense lanuginosæ, monospermæ; semen erectum; radicula linearis, recta.—*Ava, montes Khakhyen.*

20. SAPINDUS MICROCARPUS, nov. sp.

Frutex v. arbor?, ramulis novellis parce hirsutis; folia bifoliolata, petiolo 1—2 lin. tantum longo parce hirsuto glabrescente suffulta; foliola oblonga ad lineari-oblonga, basi obliquâ acuminata, 2—3½ poll. longa, obtusiuscula v. subretusa, integra, coriacea, glabra utrinque prominenter reticulata; flores parvi, glabri, pedicellis ½ lin. longis suffulti, paniculas subsessiles graciles pubescentes mox glabras terminales et axillares efformantes; baccæ vulgo profunde 2-lobæ v. abortu unilobæ, lobis obovatis divergentibus 1½—2 lin. longis glabris.—*Siam.* (Teysmana).

21. POMETIA MACROCARPA, nov. sp.

Arborea, glaberrima; folia pinnata, longa; foliola inferiora tantum adsunt inæquali oblongo-lanceolata, basi rotundata, brevissime et crasse petiolulata, acuminata, 3—4 poll. longa, remote et obsolete repanda, coriacea, supra lucida, nervis lateralibus numerosis crassis in pagina superiori immersis percursa; flores parvi, pedicellis capillaribus glabris c. 2 lin. longis suffulti, fasciculati, fasciculi racemosi in paniculas crassas subglabras collecti; calycis lobi minute ciliolati, glabri; stamina 5; ovarium parce hirsutum glabrescens; baccæ corticatæ, ellipsoideæ, ovi gallinacei magnitudine, glaberrimæ, monospermæ, cortice crasso; semen ovoideo-oblongum, ultra pollicem longum, basi breviter arillatum.—*Malacca* (Maingay No. 413).

22. DALBERGIA STENOCARPA, nov. sp.

Arbuscula, novellis aureo- v. fulvo-sericeis; folia pinnata, breviuscule petiolata, 5—8 poll. longa; foliola 9—13, alterna, elliptico-oblonga ad elliptica, petiolulo 1½—2 lin. longo sericeo-puberulo suffulta, basi subobliqua acuta, 1—1⅔ poll. longa, retusa cum mucrone minuto, chartacea, subtus glaucescentia et parce (præcipue secus nervos) pilosula; paniculæ fructigeræ puberulæ, pedunculo circa pollicari suffultæ, axillares, folio multo breviores; flores..., pedicelli 1 lin. circiter longi, puberuli; calyx 1 lin. longus, appresse fulvo-hirsutus, dente superiore brevissimo obtuso, infimo longissimo subulato; legumina 1—2 poll. longo et circa 2 lin. lata, linearia, in stipitem longum gracilem sensim attenuata, plana, brunnea, tenuiter coriacea, obtusa v. stylo terminata, laxe et indistincte venosa, 1—5-sperma, suturâ exteriori vulgo rectâ interiore sinuosâ v. leviter curvatâ.—*Sikkim, Pankabári* (S. Gamble). Fr. Aug.

Leguminum structurâ et indole ad *D. Sissoo*, ex habitu autem ad *Dalbergiam lanceolariam* accedens.

23. Fragaria Sikkimensis, nov. sp.

Perennis, estolonifera, acaulis, rhizomate crasso verticali v. obliquo; folia trifoliolata, petiolo parce piloso 2—3 pollicari suffulta; foliola elliptica ad obovato-elliptica, lateralia subobliqua, grosse crenato-serrata, obtusa, $\frac{1}{2}$—1 poll. longa, brevissime petiolulata, crasse membranacea, utrinque pilis sparsis albis rigidis adspersa; scapi solitarii foliis paullulo breviores, uniflori, parce pilosi; calycis lobi 10, spatulato-obovati, acuti, alterni breviores et angustiores, nervosæ, apicem versus dentati, 2—3 lin. longi, parce pilosi v. subglabræ, piloso-ciliati; cœnanthium cylindrico-oblongum, glabrum, $\frac{1}{2}$ poll. longum. *Sikkim-Himalaya*, in pascuis alpinis 10—15000 ped. s. m.

24. Rubus Fockeanus, nov. sp.

Prostratus et longe repens, caulibus filiformibus parce hirsutis surculosis; folia trifoliolata, iis *Fragariæ* haud absimilia, petiolo 1—2 pollicari parce piloso suffulta; foliola ovalia ad rotundato-ovalia, breviter petiolulata, obtusa, $\frac{1}{2}$—1 poll. longa, irregulariter duplicato-serrata, subplicata, secus nervos parce appresse hispidula, lateralia obliqua; flores solitarii, ramulos breves annuos unifoliolatos terminantes, pedunculo villosulo parce et minute glandulo-hispido poll. fere longo suffulti, majusculi; calycis laciniæ ovatæ, acuminatæ, 3 lin. circiter longæ, extus subglabræ, intus tomentellæ; stamina glabra, erecta?; drupeolæ perpaucæ, 1—$\frac{1}{2}$ lin. longæ, coccineæ, lucidæ. In pascuis alpinis, *Sikkim-Himalaya*, e. g. in jugis Singalilah, 12—14000 ped. s. m.

Explanation of Plate XV.

Figs. 1—7. *Daphniphyllopsis capitata*, Kurz.—Fig. 1, flowering branch, nat. size; fig. 2, flower, the petals removed; fig. 3, flower, from below; fig. 4, the same from above; fig. 5. fruiting inflorescence, nat. size; fig. 6. berry, nat. size; fig. 7. upper part of berry, shewing the persistent crown formed by the calyx-limb and epigynous disk.

Figs. 8—9. *Natsiatopsis thunbergiæfolia*, Kurz.—Fig. 8. flowering branch, nat. size; fig. 9, flower, with opened corolla, shewing stamens and ovary-rudiment.

XIX.—*Note on* (i) Elachistodon Westermanni, (ii) Platyceps semifasciatus, *and* (iii) Ablepharus pusillus *and* Blepharosteres agilis.—*By* W. T. Blanford, *F. R. S.*

(Received Nov. 9;—Read Dec. 1, 1875.)

§ I.—A young snake was recently presented to the Indian Museum by Mr. G. Shillingford, of Purneah, and Mr. Wood-Mason, the Curator, asked me to determine it. For a long time I was unsuccessful, for the specimen presents the peculiarity of a pit behind the nostril, scales much like those of a *Bungarus*, except that the subcaudals are divided, and no poison fang; but after a good deal of research I at last identified the specimen with *Elachistodon Westermanni*, Reinhardt, Oversigt K. Dansk. Vid. Selsk. Forh. Kjobenhavn, 1863, p. 210 (Gunther, Rept. Brit. Ind., Appendix).

This snake is admirably figured in the original paper, and a remarkable character not mentioned in Dr. Gunther's description is shewn in the figure. This character consists in the presence of a post-nasal pit.

A loreal pit has been found in two other genera of harmless snakes, both West African; one *Bothrolycus* belonging to the *Lycodontidæ*, (Günther, P. Z. S., 1874, p. 444, Pl. LVII, fig. B), the other *Bothrophthalmus* belonging to the *Colubridæ*. In *Elachistodon* the loreal shield is united to the nasal above and a suture runs from the edge of the pit to the labials below. In the original description the nasal was said to lie between two shields and the loreal was considered to enter the orbit, but there is certainly no suture above the nostril in the Purneah specimen and, considering the presence of the pit, I think that the lower præocular is not the loreal and that the homologies of the shields are as I have suggested.

From the character of the scales I am inclined to refer *Elachistodon* to the *Dipsadidæ*, and the dentition as described by Reinhardt agrees with this view, the posterior maxillary teeth being grooved. The following is a description of the specimen obtained.

Head scarcely broader than the neck, flat above, body somewhat compressed, tail rather short, pupil vertical, body surrounded by 15 rows of smooth scales, those on the sides as broad as long, the dorsal row enlarged, hexagonal, much broader than long. Nostrils lateral, each in a single shield, which contains a deep pit behind the nostril, the shield is divided below the pit, the suture running forwards to below the nostril and then downwards. Both palatine and maxillary teeth are present, but the specimen is too small for their characters to be made out. Ventrals 210, subcaudals in 65 pairs, anal undivided. Length 8¾ inches, of which the tail is 1·4.

Head-shields normal except that there is no separate loreal, this being united with the nasal above. Rostral twice as broad as high, just reaching the upper surface of the head. Anterior and posterior frontals equal in

length, the latter are broader and descend somewhat on to the side of the head so that the upper præocular is not in contact with the nasal. Vertical hexagonal, rather longer than broad, occipitals large, rather broad in front, 2 præoculars, the lower the larger, the higher not reaching the upper surface of the head; 2 postoculars. Upper labials 6 on one side of the head, 7 on the other, the 3rd and 4th entering the orbit, the last very large. Temporals 2, very long, the upper extending the whole length of the occipital, the lower rather shorter. Three pairs of enlarged chin-shields, the posterior separated by a small azygos scale, the second pair the largest, each being in contact with 3 lower labials. All the lower labials very narrow. *Colouration*:—a narrow white line runs along the back, it is straight on the tail, becomes wavy in the middle of the back, and tends to break up into spots near the head; sides dark brown with numerous minute elongate white spots tending to form cross bands; lower parts white, each ventral shield with a dark hinder edge, which frequently expands into irregular spots near the sides; upper surface of head blackish brown, suture between the occipital shields white, rostral and a broad line running from it over the outer part of the frontals and supraorbitals and across the temporals to the hindermost labial, and all the labials themselves, white, whilst a blackish brown band runs from the nostril to the temporals below the white line, and includes the eye.

§ II.—I had occasion recently to examine the type specimen of *Platyceps semifasciatus*, Blyth. It is a very young snake and has hitherto been a puzzle to Indian herpetologists, as may be inferred from the following synonymy:

Platyceps semifasciatus, Blyth, J. A. S. B., 1861, XXIX, p. 114; Günther, Rept. Brit. Ind. p. 237.

Coluber (Platyceps) semifasciatus, Theobald, Cat. Rept. in appendix to J. A. S. B., 1868, XXXVII, p. 52.

Compsosoma semifasciatum, Stoliczka, J. A. S. B., 1870, XXXIX, p. 188.

I venture with some diffidence to suggest that it is a young specimen of *Zamenis ventrimaculatus*, a snake with which I am very well acquainted from having found it abundantly in Persia, but which is not common in India except in the extreme west, and is necessarily not easily recognised in the young state except by one who knows its appearance well.

§ III.—On comparison of the scinque from Basrah which I described* as *Ablepharus pusillus* (A. and M. N. H. July, 1874, XIV, p. 33) with the type specimen in the Indian Museum of the species described by Dr. Stoliczka as *Blepharosteres a gilis*, I am disposed to believe that I was wrong in supposing them, on the strength of the descriptions, to be identical. They

* In this description a serious misprint occurs. The number of scales between the axils should be 36 not 26.

are congeneric without doubt, and *Blepharosteres agilis* is an *Ablepharus*, but it differs from *A. pusillus* in its much longer body. In *A. agilis* the fore limb does not nearly reach half way to the thigh and the hind limb barely reaches half way to the axil. In *A. pusillus* the fore limb reaches fully half way to the thigh or rather more and the hind limb two-thirds of the way to the axil. In the former the third and fourth toes of the fore foot are about equal in length, in the latter the third finger is decidedly the shorter. Under these circumstances I think it probable that *A. pusillus** is a distinct species and that *A agilis* is probably distinct from *A. Brandti*, Strauch.

XX.—*The Evidence of past Glacial Action in the Nágá Hills, Assam.* *By Major* H. H. Godwin-Austen, *F. R. G. S., F. Z. S.*

(Received July 25;—Read August 4, 1875.)

With Plates X—XIII.

When carrying on the survey operations in the Khási Hills, I was more than once led to think that glacial action had played a part in the denudation of some of the valleys; but the traces of such action were so slight that I hesitated to notice them. However, when writing the paper on the West Khási Hills which was published in this Journal in 1869, I alluded to the subject, with reference to the valley near Mokarsa, under the Maotherichan ridge. When mapping the Jatinga valley, I met with lines of heavy subangular débris, skirting streams from the north side of the high ridge the west extremity of the Burrail running thence to Asálu. Under and to north of the peak of Mahadeo, there is a terminal mass of transported material near where the Naga village of Garilo formerly stood. On the north of the Shillong peak, the highest part of the Khási Hills, skirting the sides of the "Umshirpi" stream, are to be seen the remnants of deposits for which it is difficult to account, unless we bring in the agency of ice, or large melting snow-beds. The "Umshirpi" has cut a deep gorge through the altered sandstones below the point where the road from Cherra Poonjee crosses it, and here takes a very sharp bend; since its original excavation, a bed of water-worn boulders has filled the valley, and caps the spur round which the stream winds, and is seen again in the road-cutting on the right bank quite 25 feet above the present stream, as one proceeds to the Artillery barracks from the station side, shewing clearly it was once continuous, and has since

* *A. pusillus* is figured in the 'Zoology of Persia,' Pl. XXVII, fig. 1.

been removed. Such a bed of transported material would again be found at this point, if large snow beds, or small glaciers were to be formed on the slopes of the Shillong peak, where the Umshirpi takes its rise, so as to produce a greater aqueous action, and sudden rushes of water. Yet I did not consider myself quite justified in attributing such appearances to more than the former greater intensity of aqueous action alone, especially on so low a latitude as 25° 30'.* However, during my last expedition into the same range further east, where it rises to nearly 10,000 feet, it was highly interesting to find the most unmistakeable signs of former considerable glacial action. By any one who has traversed a glaciated region, the slightest evidence of such action is at once detected, which to the uninitiated eye might escape notice, but the moraines of the Burrail are of such dimensions, and so partake of all the characters of glacial action having once been in full force, as to strike the most unobservant as being peculiar. Rounding the base of the Burrail on the direct road from Sámágúting towards Munipur, after passing the village of Suchéma under the curiously shaped and conspicuous scarp of Sú-vé-nú-chi-ká, descending into the deep valley of the Zubza, on viâ Jotsáma and Phésáma, Kigwéma is reached, and shortly after coming in view of this last village, the path leads up the steep terminal slope and on to the level surface of the old moraine, on which our camp was soon pitched at an elevation of 5000 ft. The imagination could picture the time when the deep valley at the back, above which towered the cliffs and peak of Japvo (the point we had to ascend and observe from), was filled with the ice that had pushed and carried the large blocks of stone and earth forward. The summit of Japvo, a trigonometrical station, is 9,890 ft. above the sea, and the mean height of this eastern part of the Burrail, which here takes a bend to the south, is about 9,000. The Tertiary rocks, which first begin to rise above all the surrounding country near Asálu, dipping S E, continue, with a gradual elevation of the base of the series for 50 miles, until they attain their highest elevation near Japvo; the south-easterly dip changes gradually round to west, and presents a precipitous face at right angles to the direction of the main watershed:—the continuity of the Burrail as a high range is thus reduced suddenly from 9,000 to 5,000 feet, and the much older contorted clay shales and schists on which the Tertiary rocks unconformably rest are exposed. Along this east face there are several deep gorges, their streams joining the Zullo, which rises under the peaks of Ténépú and Khunho. Across the low saddle of the older series, which has a breadth of 5 miles, the newer rocks again come in, with a reversed dip, at Tellizo, and its base rises again towards the N E,

* Dr. Wm. Hooker has noticed the glacial features in the Atlas Mountains; and Palgrave again south of the Caspian in lat. 36°.

forming with that strike the Kopamedza range. This sudden depression in the range, marked by the removal of the Tertiaries, stretches far away to the south, into the depression of the valley of Munipur, which is in fact the continuation of the same great lateral axis of elevation. The high N N E, S SW ridge of Tertiary sandstones, rising 7000—8000 feet, bounds the valley of Munipur for 80 miles, and marks its eastern boundary, coming in again at the Máphitel ridge, which bounds the valley on the east.

It is in the gorges draining to the Zullo river that the best examples of glacial action are to be seen, the moraine in the Gaziarurh being the largest. The tributaries of the Mazierh ravine under Japvo are numerous, and fall very suddenly from the ridge above; descending from the peak into the gorge, just below where they unite, and leaving the more confined part, and proceeding down the valley, the first signs of ice-action consist of narrow irregular terraces; until arriving at a lateral ravine at the north side of the valley, where a clearly defined small moraine projects out into the main valley of the Mazierh, to the level surface of its moraine, and would (when the glacier existed) have formed one of those little side lakes, so often seen in glaciated ground, just above the point of junction with a lateral and main glacier. Passing this side ravine, the path led along the flat surface of the moraine for half a mile, which widened gradually as the valley opened, and we then descended 200 feet into the bed of the stream. Enormous blocks shew out on the sides of the even-cut slope at an angle of 45°, and also lie near and in the bed of the present stream, the face of the slope being here very straight. The sketch (Pl. X) taken looking up the valley and one of the lateral moraine (Pl. XII, Fig. 1) will elucidate this feature. Just in a direct line opposite Kigwemah, the moraine ends at 4 miles from its source, with a terminal slope of 45°, and the stream descends rapidly to join the Zullo about 7 miles further down. The débris composing this mass of transported material having been derived from Tertiary sandstones all more or less soft, which have quickly broken up and become disintegrated, much of it must have been reduced to a state of mud and sand long before it arrived at Kigwemah, and hence it is that these moraines of the Naga Hills differ from those of the Himalaya and Alps, where the rocks are of various kinds, and often extremely hard, retaining their angular forms after travelling for a great distance. The level surface of the Mazierh moraine is now cultivated and terraced for the rice irrigation, and the sub-angular blocks and stones that formerly covered the surface have been used to build the walls of the terraces; the former distribution on the surface has thus been effaced, yet here and there collections of stones too large and heavy for removal by man still remain to shew that they moved down in the usual continuous line.

Proceeding south from Kigwémah, and reaching the next gorge at Zakameh, the scenery near it is most lovely, and the old moraine features

are very well displayed. At the point where the stream, the Gaziarurh, leaves the gorge, the broad flat expanse commences and extends down the valley for quite 1½ miles. After proceeding down and crossing it, the view from the next spur on the other side was most striking: the broad sweep of old moraine a quarter of a mile broad (terraced for cultivation) comes bending round to join the smaller one from the Kurúrurh; the two glaciers must have once met here, and the terminal cliff would have been just below the junction; the elevation is here 5,100 ft.* I give a sketch of the moraine on Pl. XIII. The views on all sides were lovely, especially that up the gorge of the Gaziarurh: the soft hazy rays of light cast by the sun, setting behind the high range on the west, brought out in most lovely grey tones the receding steep spurs that bounded the glen.

Towards the upper part of the Zúllo near where the Kaburhi joins it, traces of old terraces of transported material are observable, and huge blocks of sandstone are seen here and there, all in the same level, resting on the clay shales (one of these blocks at about 4,800 ft. measured $20 \times 18 \times 12 = 4{,}320$ cubic feet), and it is from among these transported blocks that the Nagas of Sopvomah select the monoliths and dolmens they erect in the villages along the crest of the ridge above, which is of clay shales.

Crossing the main watershed at its lowest part, we descend gradually to the head of the Barak valley, the physical aspect of which well deserves notice (Pl. XI). The river, here 3,800 ft. above sea level, flows with a very serpentine course through a broad level belt about ¼ to ½ a mile in breadth, the greater part of which is or has been under rice cultivation. There are scarcely any trees on the hill slopes, and those few that exist are confined to patches on steep slopes bordering the river, where it bends in under the hills. Alluvial terraces are well developed both in the main valley and lateral branches. Under the village of Gnámíh, the main accumulation of these deposits terminates, and below this they occur, now on one side of the valley, now on the other, extending into the narrow gorge of the river still further down where it takes a sharp loop-like bend of 6 miles, and it is evident that they once filled this gorge to a height of 130 feet; little, however, of the deposit is now left. In the more open part above, the upper level of the terraces is about 120 feet above the present level of the Barak, and they consist of strong coarse conglomerates and clay. The age of these

* This altitude may be considered very low, when we know that the extension of similar action is not seen much below 4000 ft. in the N. W. Himalaya, on a more northern latitude; but there is every reason for supposing that during the last glacial period the general distribution of land and water was nearly the same as at the present time, and that the amount of moisture borne from the south and south-west must have then been very great, producing an enormous snow-fall deepening the valleys and forcing the glaciers to a lower level.

deposits there is every reason for supposing to be the same as that of the Japvo moraines, the result of a powerful river action, due to a heavy winter snow-fall,—all the main sources of the Barak lying in lateral valleys of the Kopamedza ridge at an elevation of 7—8,000 feet.

The character of the valleys that drain away through Munipur and eventually into the Irawadi, is intimately due to former effects of climate, during the period the changes I have above described were going on. These valleys and Munipur have at one time presented the appearance of a chain of lakes, now dry, the only remnant in Munipur itself being the Loglak Lake, now of small dimensions; a description of one such tributary valley will suffice for all,—and I am informed by Dr. J. Anderson that like characters are to be seen in the country towards Yunan. On the water-parting of the Irawadi and Súrmah, one looks down on the Khongba flowing with sharp bends through a broad almost level valley. The steep slopes from the Kouprú ridge on the west terminate some two miles from the base of those on the east, and a very gradual nearly level surface of water-worn detritus covers the intermediate ground, through which run four streams from the ridge above-mentioned.

The valley on the east is bounded by a low ridge of only some 300 feet above its bed, which gives off to the east spurs rising to 1000 feet. Further down the valley, 6 miles from the watershed at Kaital-Mambi, a collection of detritus (mostly angular) forms a terrace about 50 feet above the stream, and is the termination of the long talus given off by the deep ravines on the flank of the Koupru peak, which here rises to feet some feet higher than the ridge to its north. This talus extends close up to the eastern side of the valley and undoubtedly at one time abutted on its eastern spurs forming a lake above, subsequently drained by the stream cutting its way round their present base, a process which would have commenced directly the formation of talus from Koupru ceased with the change into present climatic conditions.

A sketch (Pl. XII, Fig. 2) of the Kaital-Mambi lake bed from the watershed is given in illustration of the above features.

XXI.—*Note on a large Hare inhabiting high elevations in Western Tibet.*—*By* W. T. Blanford, *F. R. S.*

(Received. Nov. 8;—Read Decr. 1, 1875.)

In the list of mammals obtained by Dr. Stoliczka in Ladák, Eastern Turkestan, &c. (ante, p. 109), I included a hare from Ladák under the name of *L. pallipes*, but as I felt doubtful of the identification I added a note of interrogation to the name. I have since, in a collection of skins very kindly sent to me for examination by Mr. Mandelli of Darjiling, found one young and two adult specimens of a hare with an ashy grey rump, corresponding very much better with the figure and description of *L. pallipes* given by Hodgson (J. A. S. B., 1842, XI, p. 288, Pl. 3). This hare is doubtless the kind inhabiting the portions of Tibet immediately north of Sikkim, and seen by myself in Sikkim close to the frontier at the Kongra Lama pass (J. A. S. B., 1872, XLI, p. 34). It differs in several respects from the large hare of Ladák and Western Tibet, referred first, I believe, by Blyth in his 'Catalogue of the Mammals in the Museum of the Asiatic Society,' p. 131, and subsequently by myself to *L. pallipes*. The hare from Western Tibet is a larger form with proportionally shorter and differently coloured ears, the fur is less woolly, the colouration more rufous on the back, and less ashy on the rump, the dark band on the anterior surface of the ears is much less distinct and the posterior outer surface shews far less white, and the tarsi are clad with longer and denser hair. I propose to name this Western Tibetan hare, from the extremely elevated regions which it inhabits,

Lepus hypsibius, sp. nov.

L. *major, rufescens, nigro-adumbratus, subtus albus, uropygio fuscescenti-griseo, caudâ floccosâ, omnino albâ, vellere dorsali densissimo subcrispato, auribus breviusculis, capitem longitudine parum excedentibus, antice extus fusco rufescentibus, postice albescentibus vel albis. Long. corporis cum capite in corio dessicato ad* 24 *poll., tarsi* 5, *auris a capite* 4.5, *cranii* 3.6.

Hab.—*In vallibus altissimis planitiebusque provinciæ occidentalis Tibetanæ Ladak dictæ.*

Description taken from a specimen collected by Dr. Stoliczka at Kium in the Changchenmo valley, 15,500 feet above the sea, in October. Colour rufous brown more or less mixed with black on the back, dusky ashy on the rump, lower parts white with a slight rufescent tinge. Fur long, woolly rather curly and thick; on the anterior portion of the body the hairs are about $1\frac{1}{4}$ inches long, ashy at the base, further back the basal portion becomes creamy white, beyond the middle of each hair there is a blackish ring, then a pale brown one, the extremity being black. Towards the rump, the hairs are

fully two inches long, and for the most part ashy grey throughout, a few only having short black tips. On the sides the hair is rufous brown, except at the base, where it is ashy, on the lower parts white with a slight rufous tinge throughout. On the neck the hairs are rufous brown, those on the back of the neck having ashy tips; on the breast they are paler rufous. Head brown, whitish round the eyes, whiskers partly black, partly white; inside surface of ears brown in front, whitish behind, the brown hairs having short black tips, no distinct dark band in front. Extreme tip of ears black, the colour only running a short distance down each margin. Ears inside clad, towards the tip and posterior margin, with buff hairs, a brown band near the hinder margin, which is buff. Tail white throughout. Limbs chiefly white, a brownish band running down the anterior portion of the fore legs.

The skull measures 3·63 inches long from the occipital plane to the front of the incisor teeth, and 1·73 broad across the widest portion of the zygomatic arches.

This hare appears to be found throughout a considerable tract in Western Tibet. The specimen in the Asiatic Society's collection was presented by Captain Smyth, but has no precise locality. This species is probably the *L. oiostolus* of Adams, P. Z. S., 1858, p. 520. I do not think it is the *L. oiostolus* of Hodgson, for a young specimen of *L. pallipes* agrees much better with Hodgson's description, and the ears in the former are said by Waterhouse* to be coloured like those of *L. Tibetanus*. This is not the case in *L. hypsibius*.

XXII.—*On new or little-known species of* Phasmidæ, *with a brief preliminary Notice of the Occurrence of a Clasping Apparatus in the Males throughout the Family.—By* James Wood-Mason.

(Recd. Decr. 10th, 1875;—Read Jan. 5th, 1876.)

(With Plates XVI & XVII.)

Lonchodes Westwoodii.

♀ *Bacillus Westwoodii*, Wood-Mason, J. A. S. B., Vol. XLII, 1873, p. 51, pl. V. figs. 1, 2; P. A. S. B., July, 1873, p 149, and A. & M. N. H., 4th Ser., 1873, Vol. XII, p. 348.

♂. Body and limbs, especially the anterior pair, of excessive tenuity; the average width of the former not exceeding three-fourths of a line. Antennæ filiform, 22-jointed, all but as long as the five basal abdominal segments taken together. Head a complete miniature of that of the female,

* Rodentia, p. 62.

being similarly armed with two minute spiniform tubercles. Meso- and metathorax dilated at the insertion of the legs. Abdomen exactly half the length of the body; terminal dorsal segment strongly carinate, its posterior and inferior angles produced into slender deflexed processes in contact at their tips only, which, like the sides of the resultant hiatus, are beset with minute spinules; terminal ventral segment pointed, carinate below for its posterior two-thirds. Legs simple except for the presence of minute representatives of the triangular spines seen near the apex of the femora in the opposite sex; their relative length 1, 3, 2.

Total length, 3 in. 4 lin.; head, $1\frac{1}{2}$ lin.; proth., $1\frac{1}{4}$ lin.; mesoth., 9 lin.; metath., $7\frac{1}{2}$ lin.; abd. $16\frac{1}{2} + 4 = 20\frac{1}{2}$ lin.; antennæ, 14 lin.; fore femora, 17, tibiæ, $20\frac{1}{2}$, tarsi, $6 = 43\frac{1}{2}$ lin.; inter. femora, 11, tibiæ, 12, tarsi, $4 = 27$ lin.; post. femora, 13, tibiæ, 16, tarsi, $4\frac{1}{2} = 33\frac{1}{2}$ lin.

Hab. The above description is taken from a specimen preserved in alcohol captured on South Andaman by Mr. A. de Roepstorff.

Lonchodes Austeni, n. sp.

♂. In size, thickness, and armature like the *Acanthoderus Wallacei* of Westwood, but without the lateral spines and with a longer head and more prominent eyes; antennæ long and setaceous; head, pro- meso- and metanotum with a few minute granules, especially on the edges of the two last named; meso- and metathorax carinate above and below; the mesonotum, both divisions of the metanotum, and the abdominal segments armed with an erect spine at their extreme hinder ends, the abdominal spines gradually decreasing in size backwards so as to become almost imperceptible tubercles on the two penultimate segments; terminal ventral and dorsal abdominal segments much as in *L. luteoviridis.* Intermediate and posterior femora with two minute spines near the apex below; relative length of the legs 1, 3, 2, the posterior being very little shorter than the anterior pair.

Female unknown.

Total length, $2\frac{1}{2}$ in.; head, $1\frac{3}{4}$ lin.; proth., $1\frac{1}{2}$ lin.; mesoth., $7\frac{1}{2}$ lin.; metath., $4\frac{3}{4}$ lin.; abd., $12 + 3 = 15$ lin.; antenn., $20\frac{1}{2}$ lin.; fore fem. 10 lin., tibiæ, 12 lin.; interm. fem. $7\frac{1}{2}$, tibiæ, 8 lin.; post. fem. 9 lin.; tibiæ, 12 lin.

Hab.—Dikrang Valley, Assam; collected during the Dafla Expedition, by Major H. H. Godwin-Austen, after whom I have much pleasure in naming it.

Phibalosoma Westwoodii, n. sp.

♀ Very closely allied to *P. Cantori*, from which it differs in the great development of the lateral lobes of the 6th dorsal abdominal segment, and in the form of the head, the occipital region of which is broad, high, and convex, and surmounted by two rounded tubercles of very unequal size

that of the right side being by far the larger; minute scale-like rudiments of tegmina and wings.

Total length, 9 in. $4\frac{1}{2}$ lin.; antennæ, 1 in. $7\frac{1}{2}$ lin.; head, 7 lin.; prothorax, $5\frac{1}{2}$ lin.; mesothorax, 1 in. $9\frac{1}{2}$ lin.; metathorax, 1 in. $3\frac{1}{2}$ lin. abdomen, 4 in. 1 lin. + 1 in. $2\frac{1}{2}$ lin. = 5 in. $3\frac{1}{2}$ lin.; breadth of 6th abd. segment at base, $3\frac{1}{2}$ lin., of the same at apex, $8\frac{1}{2}$ lin.

Male unknown.

HAB. Nazeerah (Foster) and Samaguting (J. Butler), Assam.

I have much pleasure in naming this gigantic insect after my friend and former teacher Professor Westwood, Hope Professor of Zoology in the University of Oxford.

LOPAPHUS IOLAS, Westw.

♂ *Necroscia Iolas*, Westw., Monograph of Phasmidæ, p. 145, pl. xix, fig. 2.

♀. Much stouter than the male, about the same size and thickness, and relative proportions as *Bacteria Baucis*, but with the mesothorax narrowed in front; head, and pro- and mesonotum with scattered granules; legs armed as in the male; tegmina in the form of small closely appressed overlapping scales; not the faintest trace of wings; terminal dorsal abdominal segment and operculum much as in *Bacteria Baucis* and *Lonchodes Bootanicus.*

Total length, 4 in. $6\frac{3}{4}$ lin.; head, $2\frac{1}{2}$ lin.; proth. $2\frac{3}{4}$ lin.; mesoth., 13 lin.; metath., $5\frac{1}{2}$ lin.; abd., 2 in $2\frac{3}{4}$ lin. + 5 = 2 in. $7\frac{3}{4}$ lin.; antenn., 3 in. 5 lin.; tegmina, 2 lin.

The following are the admeasurements of a specimen of the male:

Total length, 3 in. 2 lin.; head, $1\frac{1}{2}$ lin.; proth., $1\frac{3}{4}$ lin.; mesoth., 8 lin.; metath., 4 lin.; abd., $18\frac{1}{2} + 3\frac{1}{2} = 22$ lin.; antenn., 2 in. 9 lin.; tegmina, $2\frac{3}{4}$ lin.; expanse of wings, 2 in. 11 lin., or reaching as far as to the apex of the 4th abdominal segment.

HAB.—Johore, in the Malay peninsula, and Sinkieb Island, off the N. E. coast of Sumatra, where the specimens were taken by my native collector. Professor Westwood's *Necroscia Iolas* was from Malacca.

Were it not for the presence of wings in the male and of rudimentary tegmina in the female, this species would have to be placed next to *Lonchodes porus*, Westw., the female of which will, I feel confident, prove to be either *Lonchodes Bootanicus* or *Bacteria Baucis*, or at any rate some closely similar form. It is placed, provisionally, in the genus *Lopaphus*, because the nearest winged ally of the female is indubitably the *Lopaphus brachypterus* of De Haan; but it might also have been ranged with the *Phibalosomas*, the females of some of which have minute scale-like rudiments of organs of flight, in the shape of mere adnate processes of the dorsal integument of the meso- and metathorax.

PHYLLIUM SICCIFOLIUM.

Having never met with a specimen of this species in the numerous collections that have been submitted to my inspection since my arrival in this country, but having received one from Mauritius, I am forced to the conclusion that it is confined to Mauritius and some of the neighbouring islands, and that the specimens from Java, Timor, and New Guinea referred to it by De Haan have, as Westwood has suggested, been incorrectly determined. The latter author states that " in the Hopeian collection at Oxford there is one from the collection of Latreille with the locality " Seychelles" attached to it in his handwriting" : the locality now given thus corroborates that of the celebrated French entomologist.

PHYLLIUM CELEBICUM, DeHaan, Pl. XVI.

Some time ago I received, through the kindness of the hon'ble Ashley Eden, to whom the Indian Museum has many times been indebted for valuable specimens, two examples—the one an adult female, the other a pupa of the same sex,—of a species which I have been unable to distinguish from the above, the adult specimen only appearing to differ from De Haan's typical one from the island of Celebes in the greater length of its tegmina and wings, but in the latter respect very nearly agreeing with a specimen from Manilla in the Hope Collection at Oxford.

The following are the admeasurements of Mr. Eden's adult specimen :—

Total length, 3 in. 3 lin.; head, $3\frac{1}{2}$ lin. ; proth. $2\frac{3}{4}$ lin.; mesoth., $3\frac{1}{2}$ lin.; metath., $4\frac{1}{4}$ lin.; abd., 1 in. 7 lin. + 6 lin. = 2 in. 1 lin.; width of 3rd abd. segm. at middle, 1 in. 3 lin.; do. of 6th at base, 1 in. $2\frac{1}{2}$ lin.; do. of same at apex and of 7th at base, $8\frac{1}{2}$ lin.; length of wings 1 in. $7\frac{1}{2}$ lin., or reaching to apex of 5th segm.; do. of tegmina, 2 in., or nearly to apex of 6th ; width of do. 8 lin.; width of post. lobe of ant. fem. $3\frac{3}{4}$ lin.; do. of ant. lobe, $2\frac{1}{4}$ lin.

HAB.—Karen country, Burmah.

The fourth abdominal segment of the pupa is biocellated, as in the male, but not the faintest trace of these ocelli is detectible in the perfect insect.

PHYLLIUM WESTWOODII, n. sp., Pl. XVII.

♀. Legs all similar to those of *P. siccifolium;* wings reaching as far as to a little beyond the second abdominal segment; the tegmina to the apex of the sixth; mesothorax granulated above and below and at the sides; abdomen gradually widening from the base to the angulation which occurs a little beyond the middle of its third segment; from this point narrowing, at first very gradually, at last somewhat more rapidly to the apex of the 6th so that its sides are slightly and regularly arcuate; its three terminal segments forming together a triangular mass, the sides of the seventh

slightly concave ; the operculum reaching almost to the apex of the basal third of the terminal dorsal segment.

♂. Legs all exactly as in the female ; the antennæ, which are tomentose, as long as the wings, and composed of 26 very distinct joints, all produced into a point below at apex, when laid back reach quite as far as to the apex of the 4th abdominal segment ; the tegmina extend to the middle of the 2nd, the wings to the apex of the 7th abdominal segment. Abdomen, at first very slightly and gradually, then more suddenly widening to a little beyond the middle of the 3rd segment ; thence maintaining the same width to apex of 4th, whence at first very gradually and afterwards more suddenly narrowing to its extremity, the sides being slightly arcuate ; a faintly marked pair of ocelli on the posterior half of 4th segment ; the three terminal ventral segments carinate below, the last of them broadly rounded at the tip and barely reaching the level of the end of the basal third of the terminal dorsal one.

♀. Total length, 4 in. ; head, 4 lin. ; proth., $3\frac{1}{4}$ lin. ; mesoth., $5\frac{1}{4}$ lin. : metath., 6 lin. ; abdom., 2 in. + $7\frac{1}{2}$ lin. = 2 in. $7\frac{1}{2}$ lin. ; breadth of 3rd segm. abdom. at angulation 20 lin. ; do. of 6th at base, 1 in. 4 lin. ; do. of 6th at apex, $10\frac{1}{2}$ lin. ; width of post. lobe of ant. fem. 3 lin. ; do. of ant. lobe, $2\frac{1}{4}$ lin. ; length of tegmina, 2 in. 7 lin., width of do. 10 lin. ; length of wings, 1 in. 2 lin.

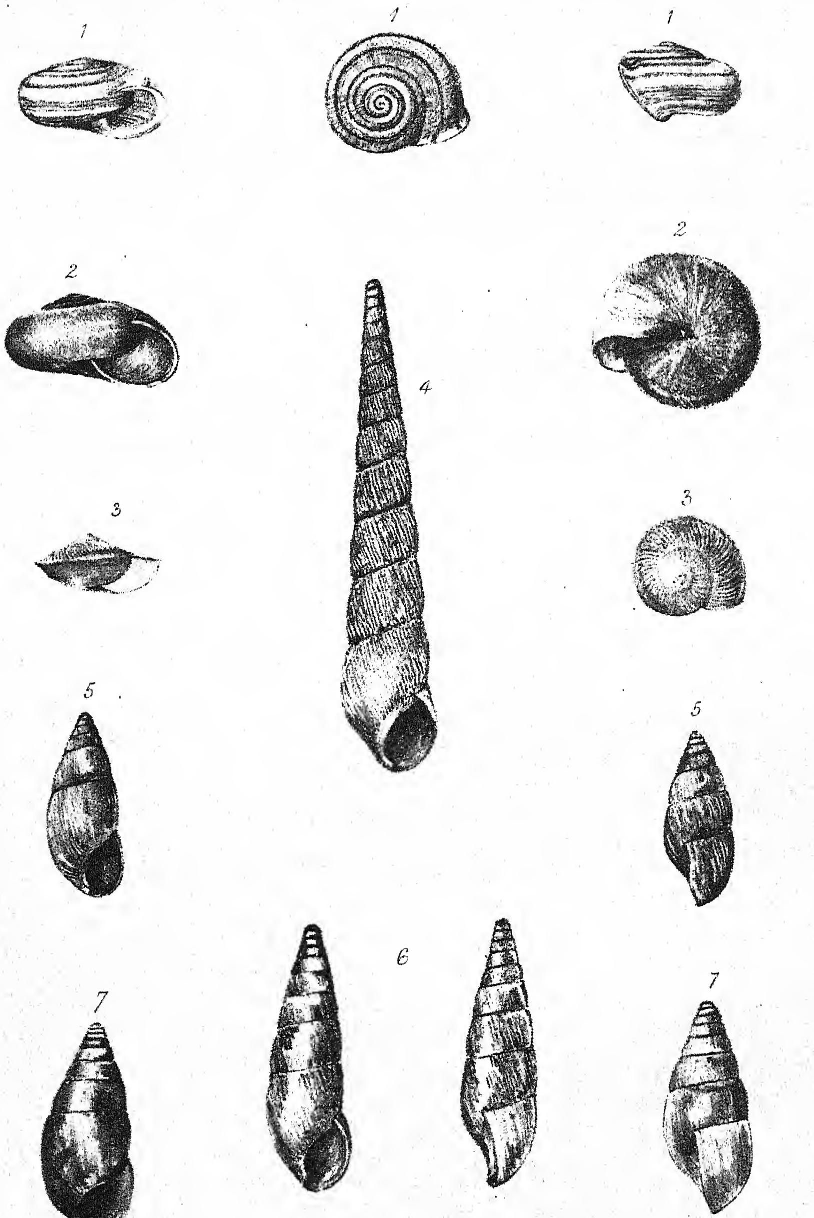
♂. Total length, 2 in. 9 lin. ; head, 2 lin. ; proth., $1\frac{3}{4}$ lin. ; mesoth. (measured below), $3\frac{1}{4}$ lin. ; metath. (measured below), $4\frac{1}{2}$ lin. ; abd., 1 in. $5\frac{1}{2}$ lin. + $4\frac{3}{4}$ lin. = 1 in. $10\frac{1}{4}$ lin. ; breadth of do. at base 4 lin. ; of 3rd segt. at angulation, $8\frac{1}{2}$ lin. ; of 5th at apex $7\frac{1}{2}$ lin. ; of 6th at apex 5 lin. ; length of tegmina, $10\frac{1}{2}$ lin. ; of wings, 2 in. ; of antennæ, 2 in.

All the above measurements are taken from alcoholic specimens.

Hab.—The female from South Andaman, where it was captured by Captain Protheroe on his dining table, so that the females of this species must possess some considerable powers of flight. The insect which I confidently believe to be the male of this species was taken by Mr. W. Davison, near Pahpoon, about 150 miles north of Moulmein, in the Salween country. The acquisition of a male from Port Blair or of a female from Burmah will alone decide whether these two insects have been legitimately paired or not.

The female differs from that of *P. siccifolium* in having tolerably well-developed wings instead of minute scale-like rudiments of such, in the shape of the abdomen, in which three instead of two segments go to form the triangular termination, and by its less strongly serrated mesothorax ; and from that of *P. Celebicum* in the form of the external lobes of the fore femora, which are semioval instead of angulated, and notably in the form of the abdomen ; in which latter point the male differs most conspicuously from that of the same species.

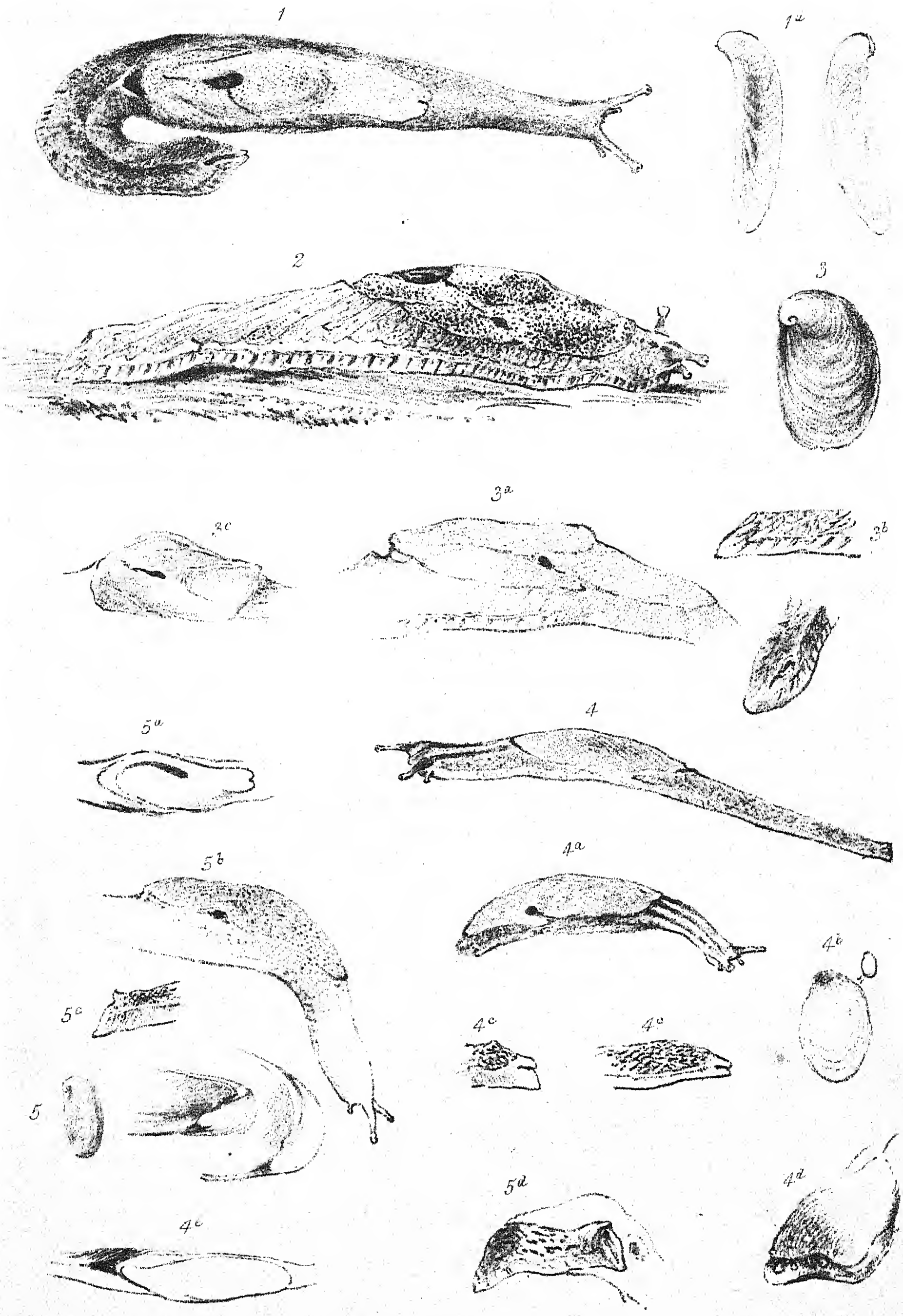
I take this opportunity of stating that the terminal dorsal abdominal segment in the males of all the species belonging to this family of Orthopterous insects with the exception of those of the genus *Phyllium* is modified to serve as a more or less efficient clasping apparatus. In its simplest form, this consists of a number of very minute highly indurated dark brown spinules developed upon the under surface of the segment near its hinder margin (*Bacillus hispidulus*, W-M., etc.) ; very frequently, however, the whole segment is so profoundly modified as to constitute a regular forceps (most species of *Lonchodes*, *Phibalosoma hypharpax*, *Podacanthus Typhon*, etc.), the arms of which are in contact throughout their length and beset internally with interlocking teeth, or in contact and spined at their extremities only ; these extremes of simplicity and specialization being connected by every conceivable gradation. In correlation, the anal cerci, which are invariably straight in the females, are curved and decussated. But neither has this condition of the anal cerci been hitherto recognized as appertaining exclusively to the male sex, nor have the structures to which a prehensile and retentive function is now for the first time assigned been interpreted, although both have been figured and described in numerous species by Professor Westwood and others.



Godwin-Austen del.

SPECIES
OF
HELICIDÆ,
N. E. FRONTIER, BENGAL.

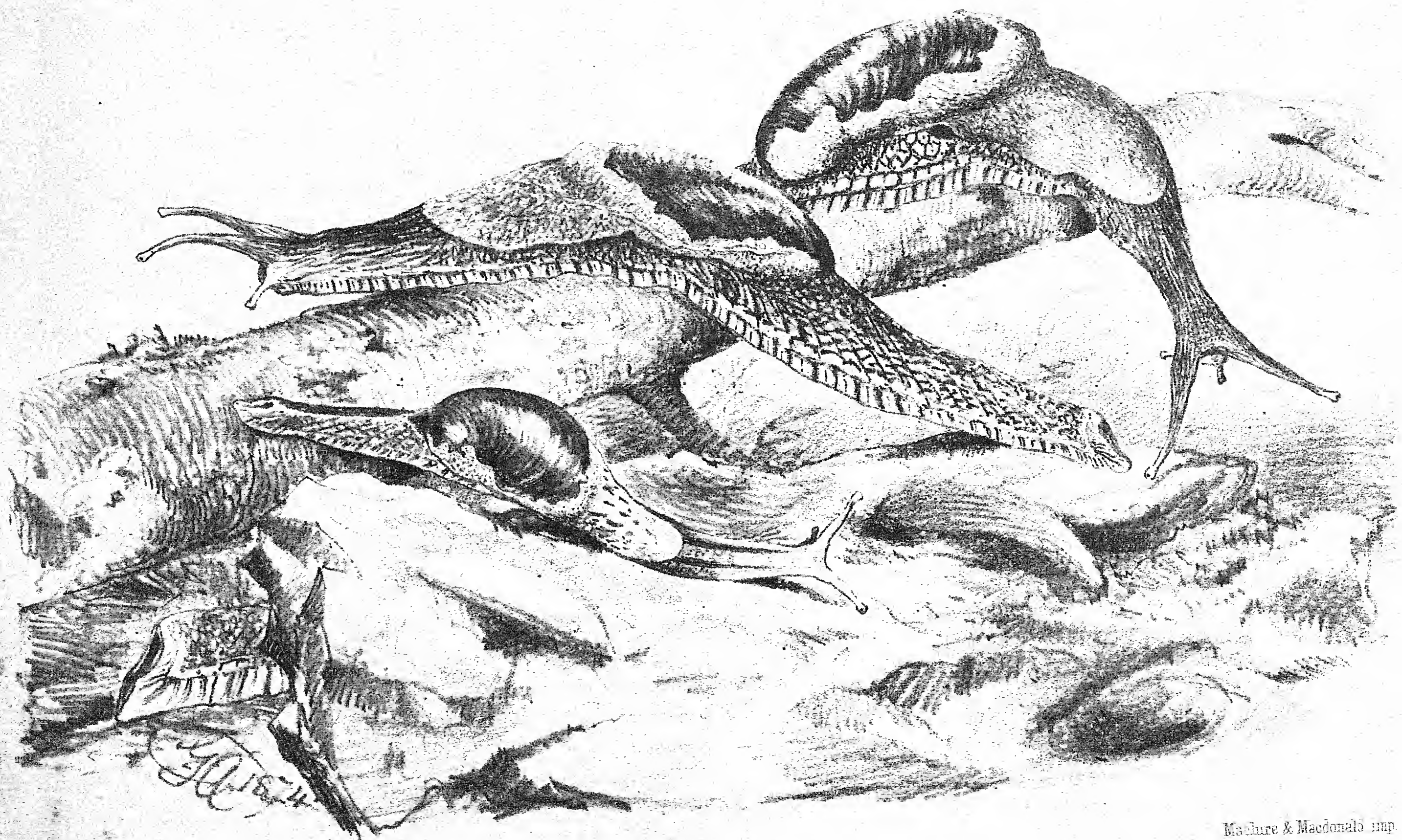
Maclure & Macdonald Lith.



Godwin Austen, del.

SPECIES
OF
HELICIDÆ, &c.
N. E. FRONTIER, BENGAL.

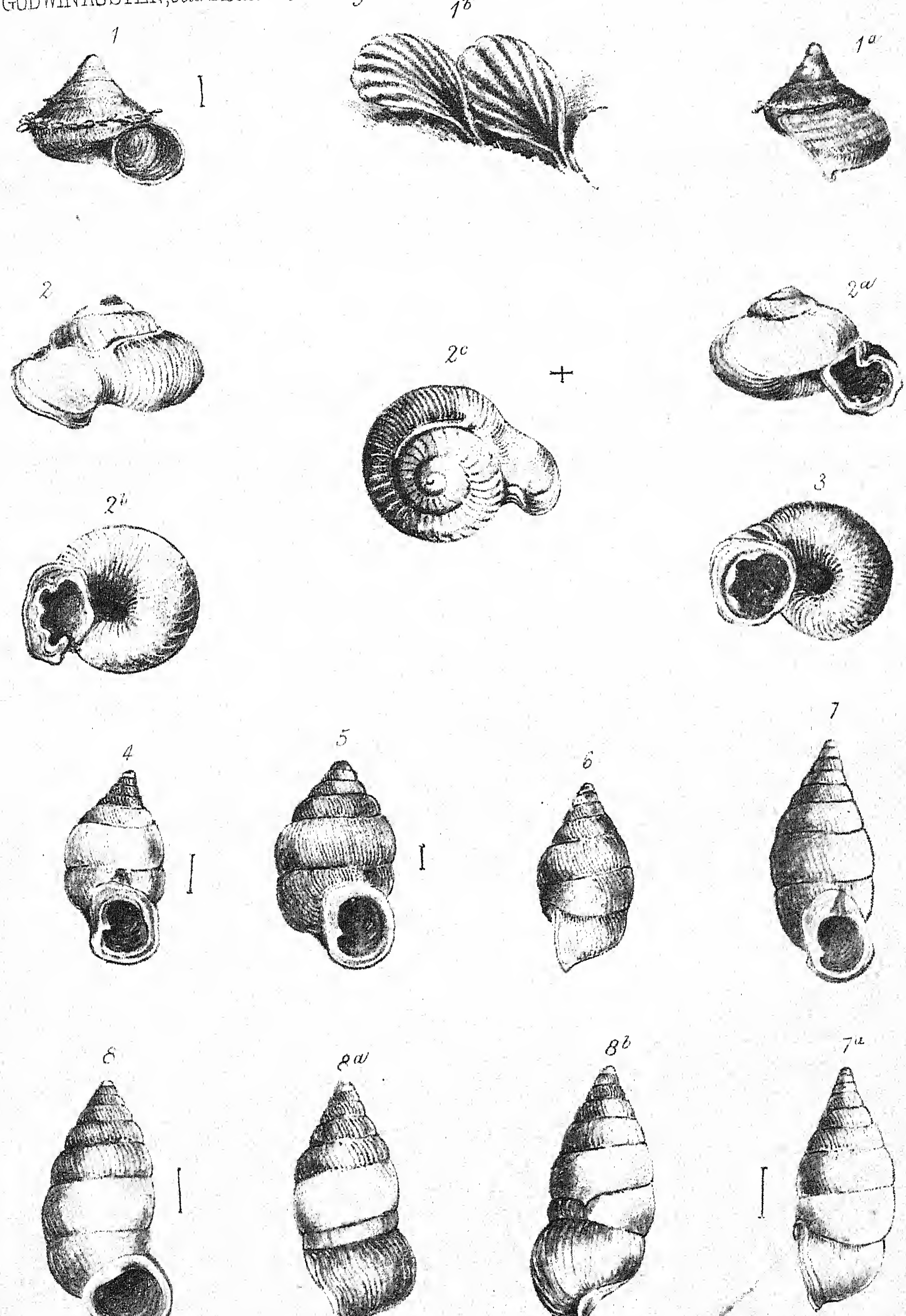
Maclure & Macdonald, Lith.



Godwin-Austen, del.

Maclure & Macdonald imp.

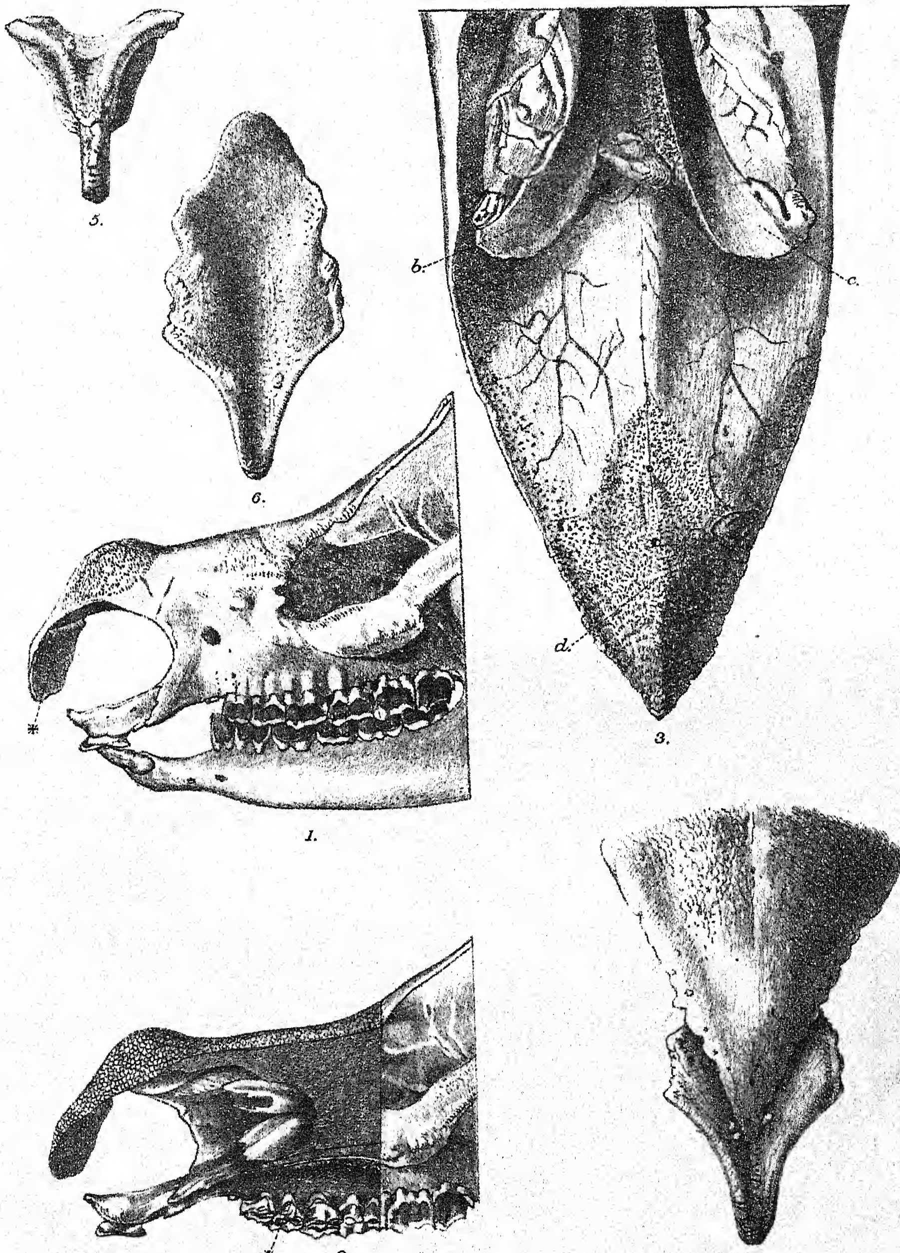
HELICARION GIGAS, nat. size.
" " var. minor.



Godwin-Austen, del.

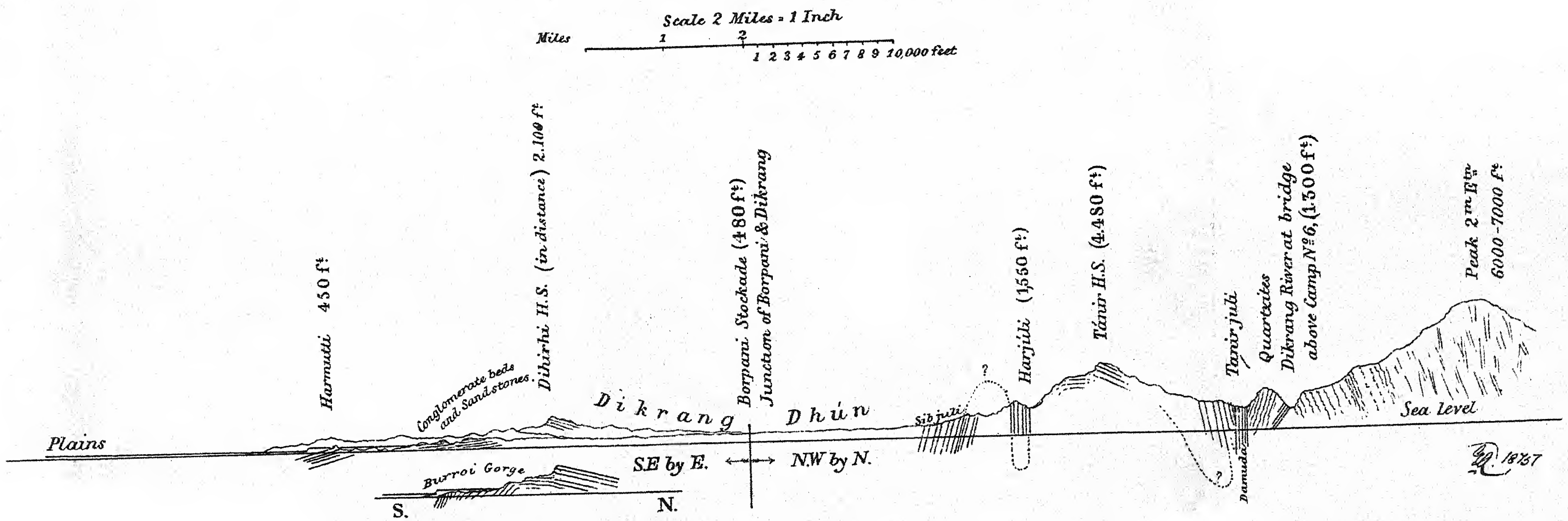
Maclure & Macdonald, imp.

SPECIES OF



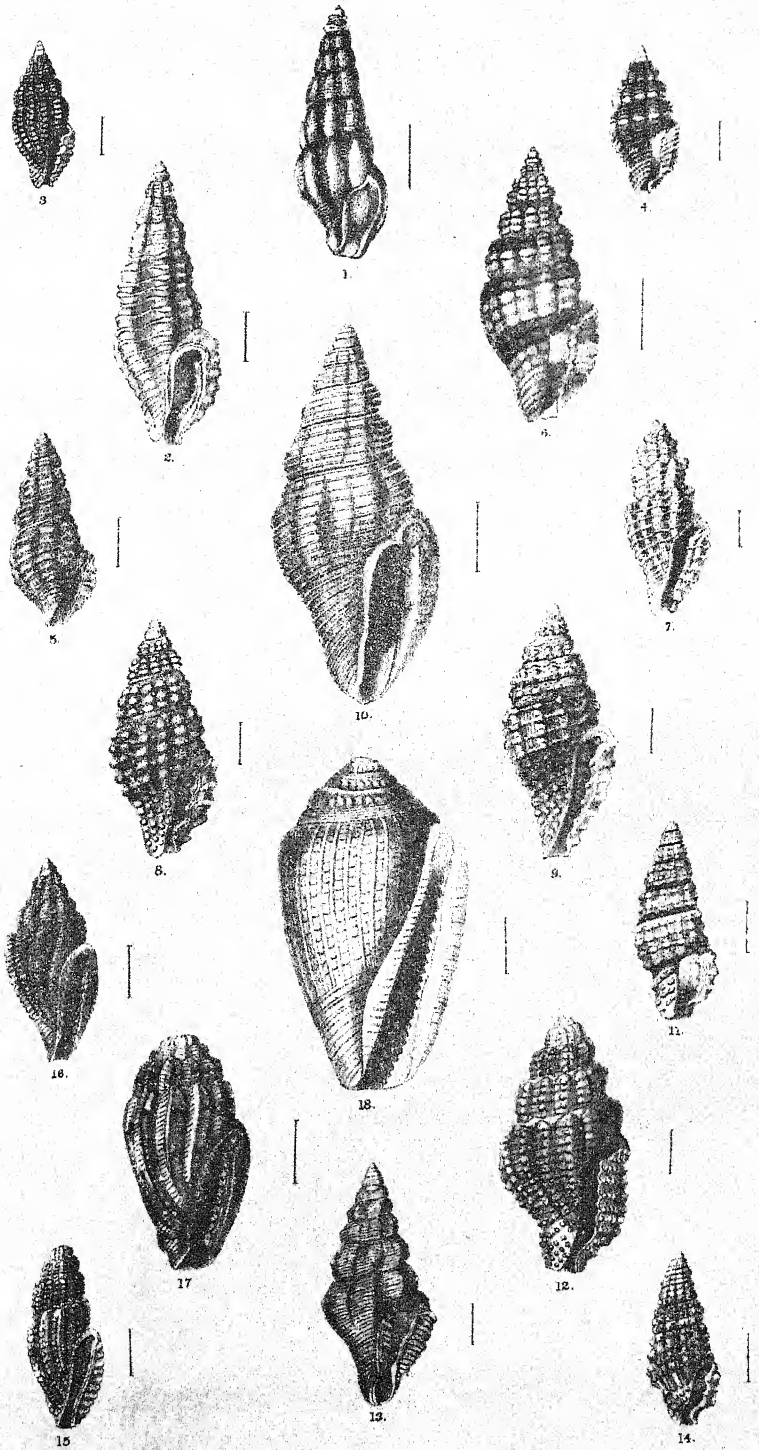
J. Schaumburg, Lith.

RHINOCEROS SONDAICUS.

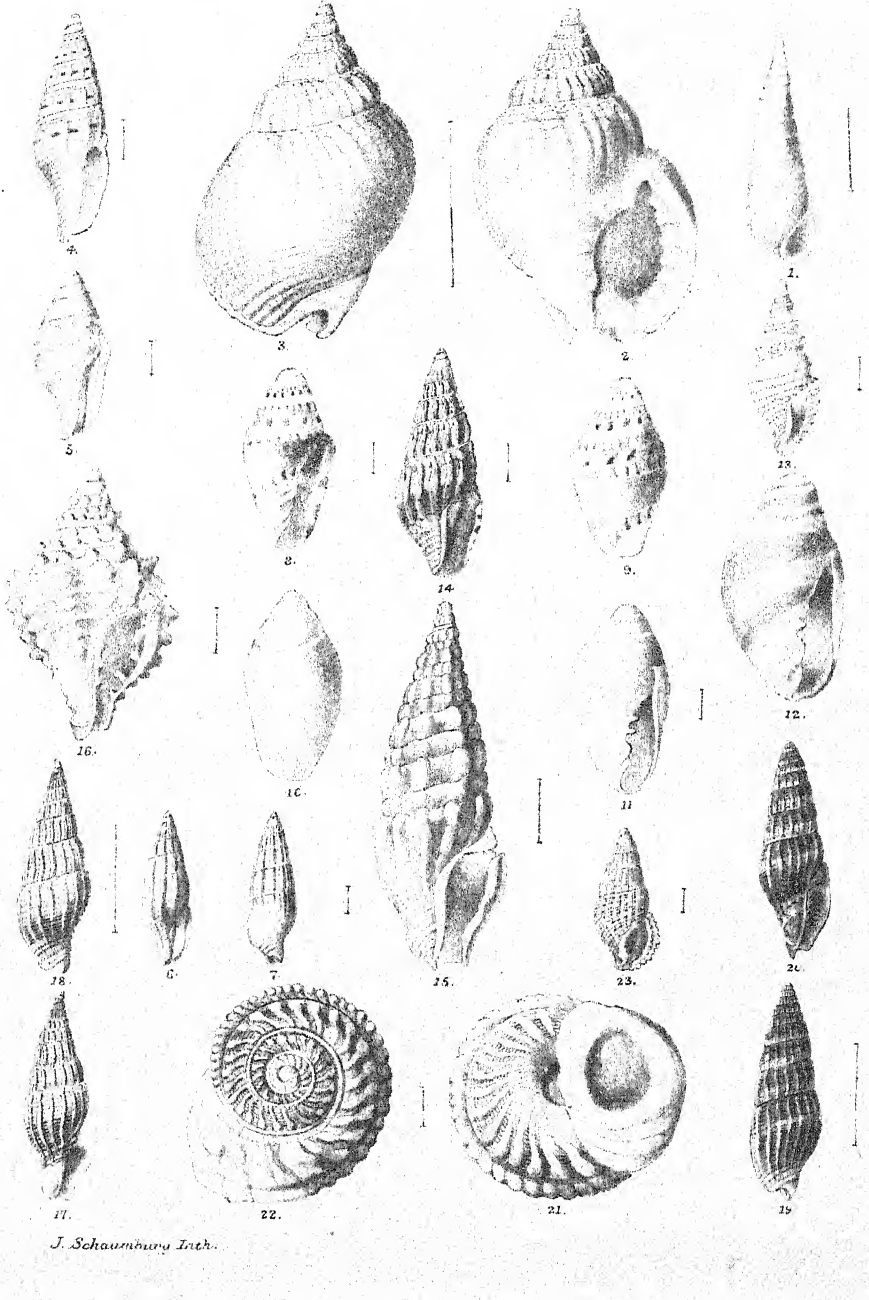


Photozincographed at the Surveyor General's Office

SECTION THROUGH THE OUTER DAFLA HILLS.



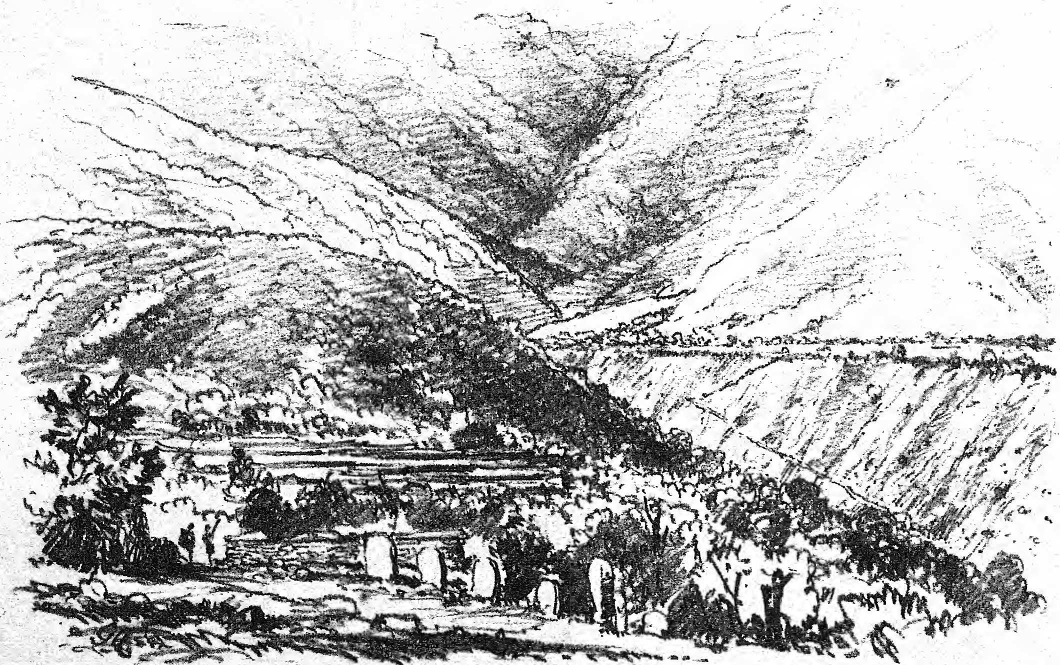
J. Schaumburg, Lith. Calcutta.



J. Schaumburg Lith.

Photozincographed at the Surveyor General's Office, Calcutta.

MAP OF PART OF THE DAFLA HILLS

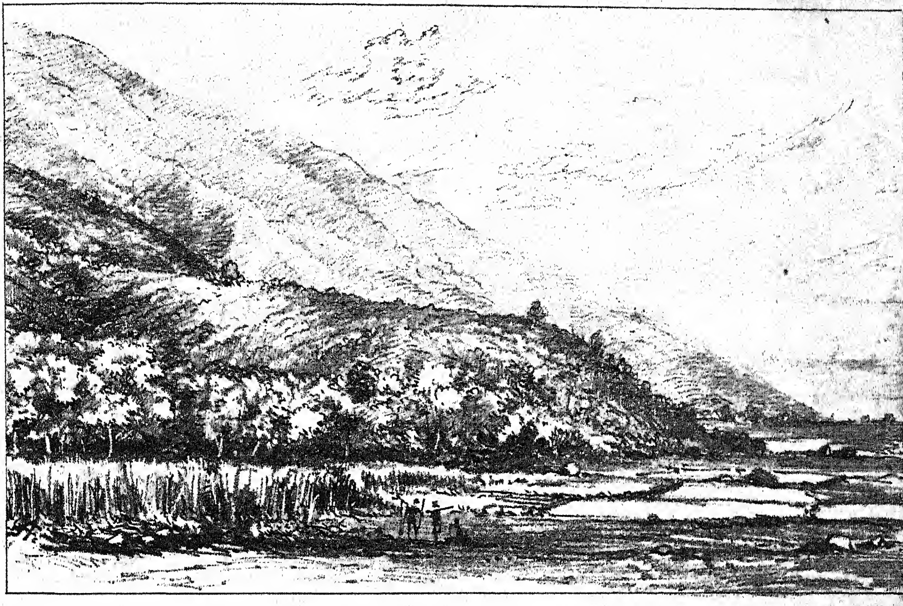


Zincographed at the Surveyor General's Office Calcutta.

MORAINE IN MAZIERH RAVINE, NAGA HILLS.

Lithographed at the Surveyor General's Office Calcutta.

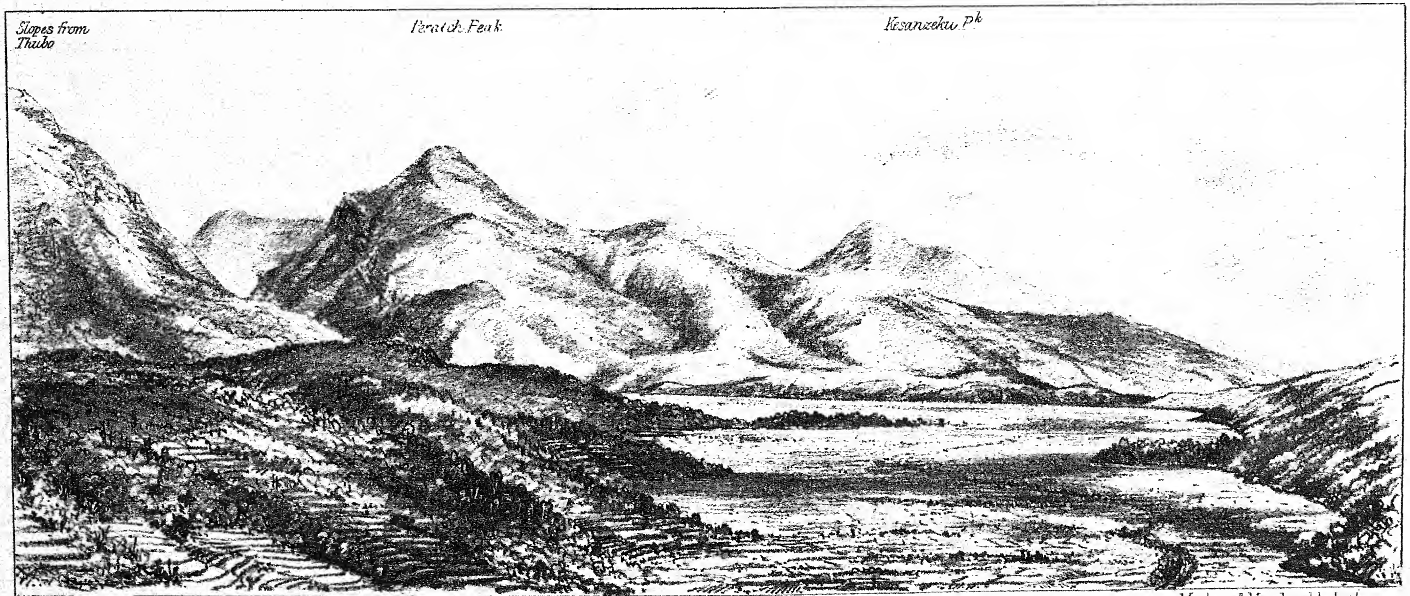
ALLUVIAL TERRACES—HEAD OF BARAK VALLEY.



(Fig 1) LATERAL MORAINE, MÁZIERH RAVINE, NÁGÁ HILLS.

Godwin-Austen Del. Maclure & Macdonald Lith.

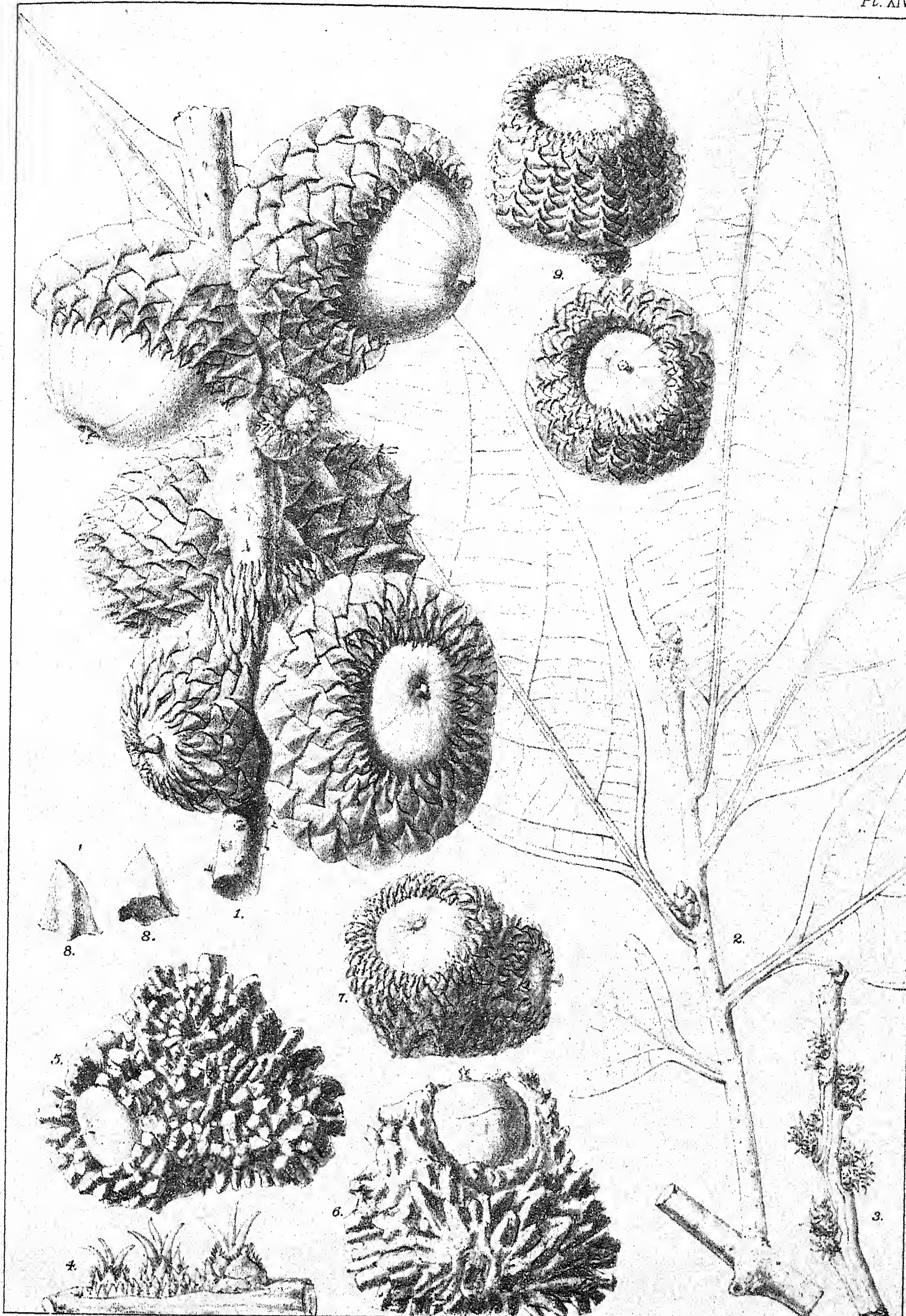
(Fig 2) LOOKING DOWN THE KHONGBA VALLEY. MUNIPUR. (Old Lake Bed)



Godwin-Austen del.

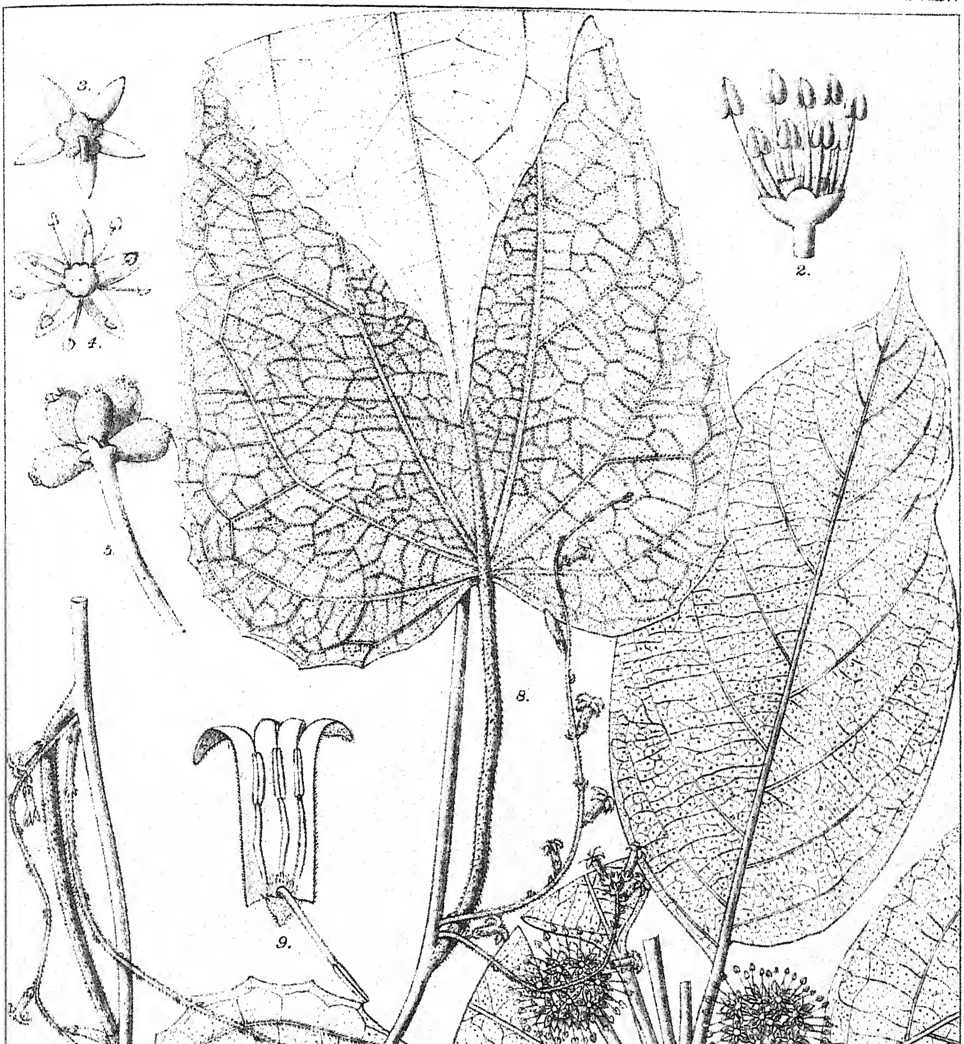
Maclure & Macdonald Lith.

GÁZIA RURH MORAINE, near ZÁKÁMÉH, NÁGA HILLS.



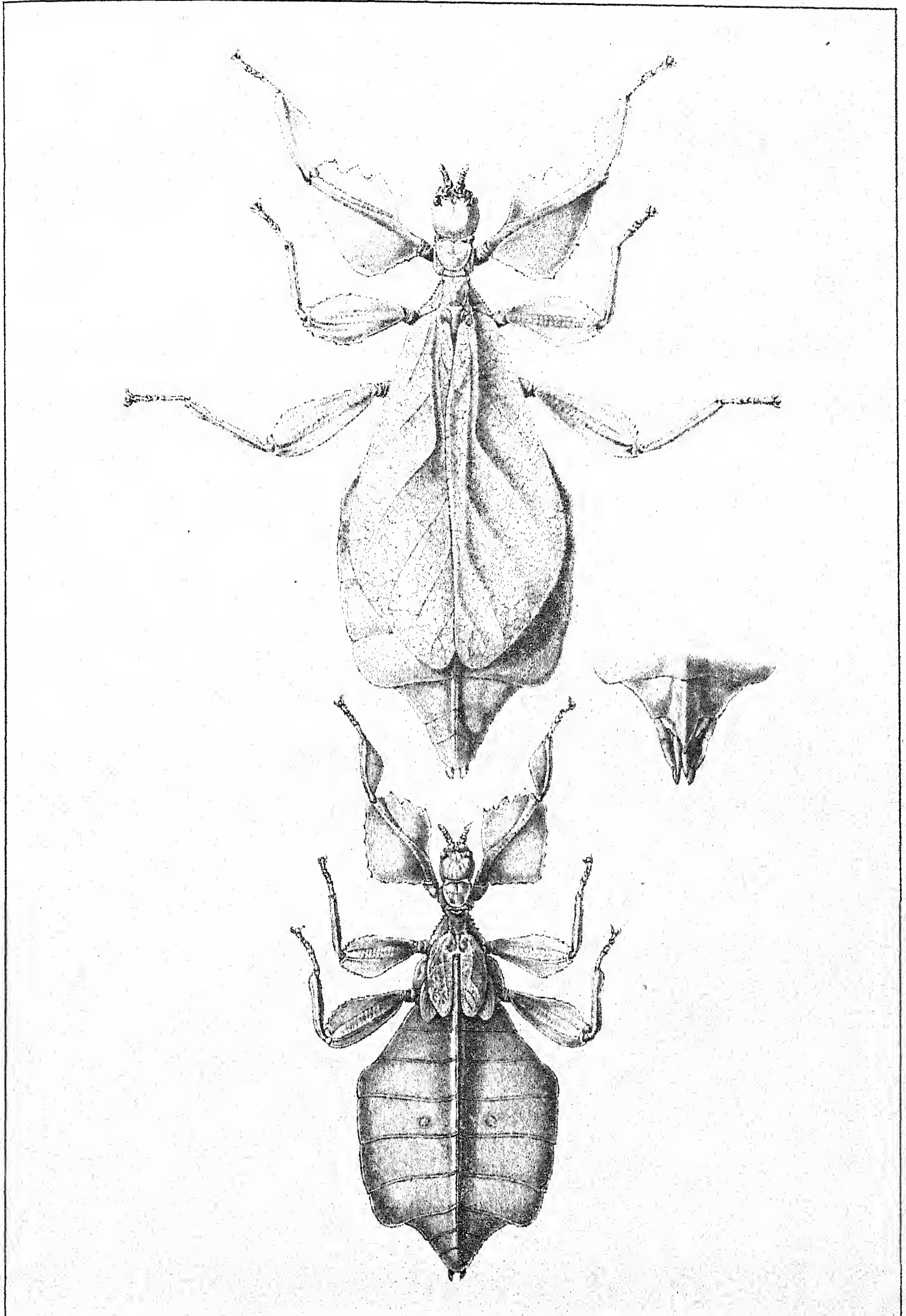
S. Sedgfield, Lith. Calcutta.

1-4. QUERCUS PACHYPHYLLA. 5-8. Q. XYLOCARPA. 9. Q. OLLA.



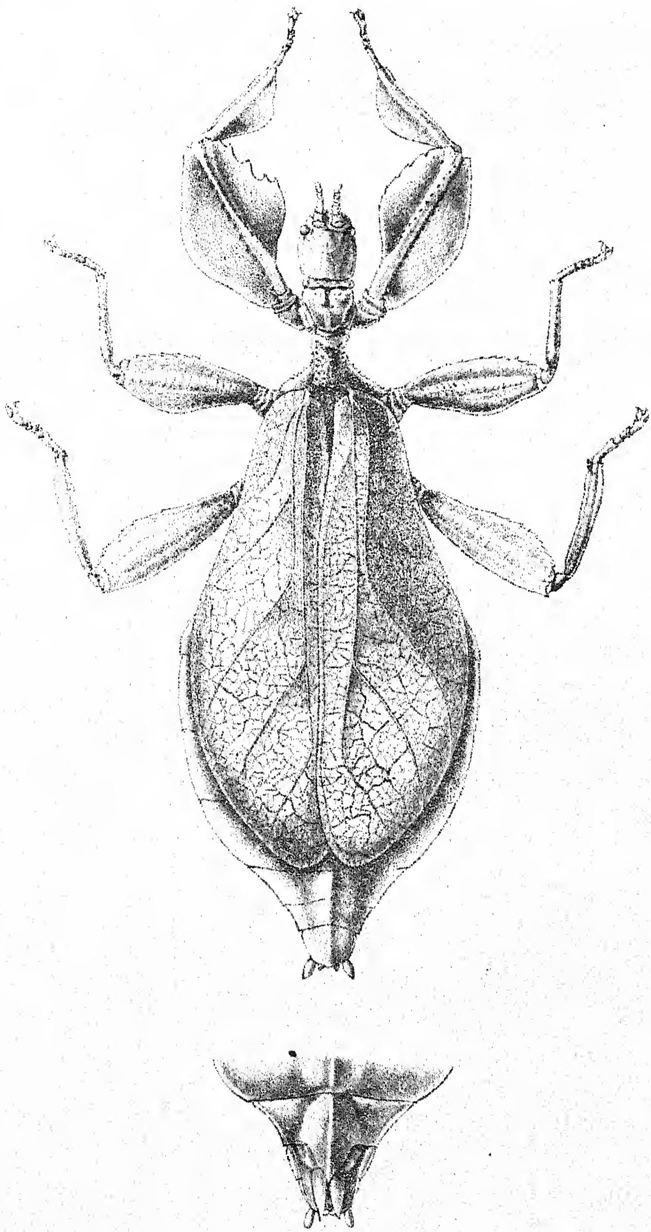
S. Sedgfield Lith: Calcutta.

1-7. DAPHNIPHYLLOPSIS CAPITATA.
8-9. NATSIATOPSIS THUNBERGIÆFOLIA.



J. Schaumburg, Lith:

PHYLLIUM CELEBICUM. ♀



J. Schaumburg, Lith:

PHYLLIUM WESTWOODII. ♀

INDEX.

☞ Names of new genera and species have an asterisk (*) prefixed.

ADDITIONS AND ERRATA.

Page 135, 16 lines from bottom of page, *for* " Geoff." *read* " Griff."
Page 136, 6 lines from top of page, *for* " its," *read* " it."
Page 151, 8 lines from top of page, *for* " *Conspectus of species*," *read* " *Conspectus of genera*."
Page 161, 13 lines from bottom of page, *for* " *monotana*," *read* " *montana*."
Page 170, 6 lines from top of page, *for* " *Conspectus of species*," *read* " *Conspectus of genera*."
Page 180, 19 lines from top of page, ***beneath*** the word " SAPINDACEÆ," ***insert*** the words " *Conspectus of genera*."
Page 198, 6 lines from top of page, *for* " Upper Assam," *read* " Upper Tenasserim."
Page 112, 9 lines from bottom of page, *for* CAPRIOLUS, *read* CAPREOLUS.